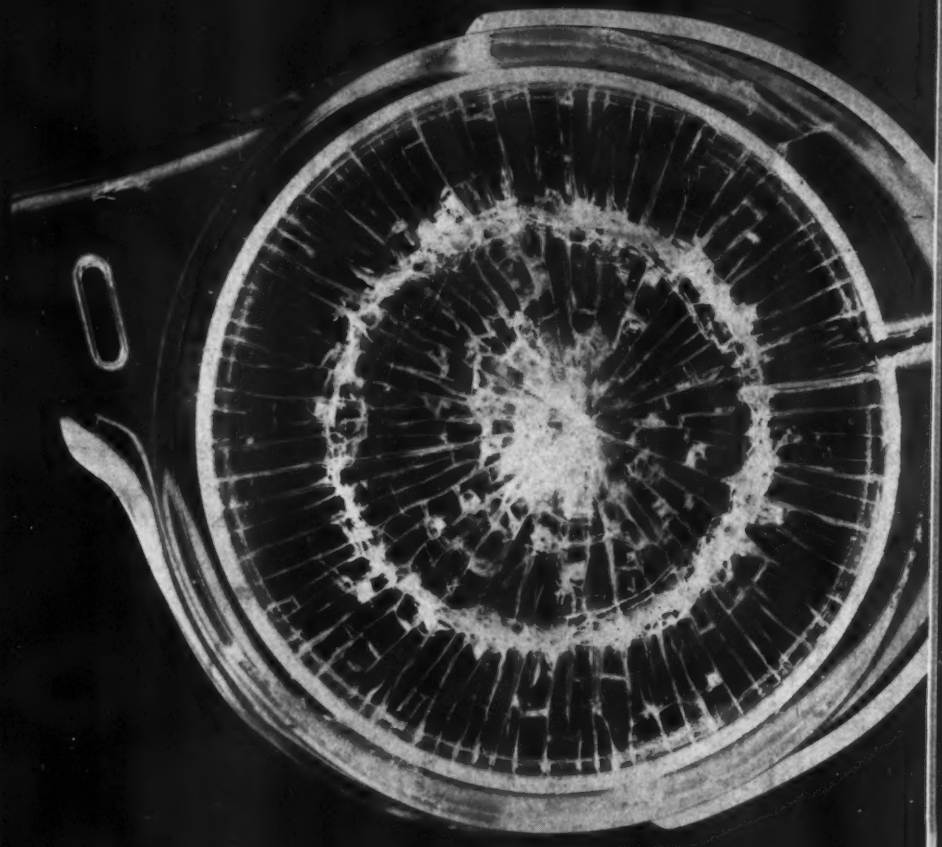
the glass industry



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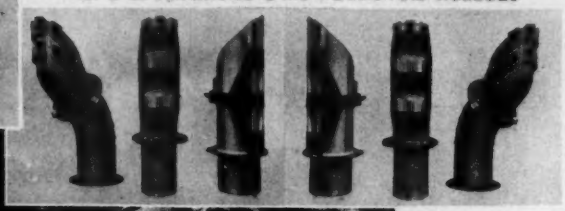

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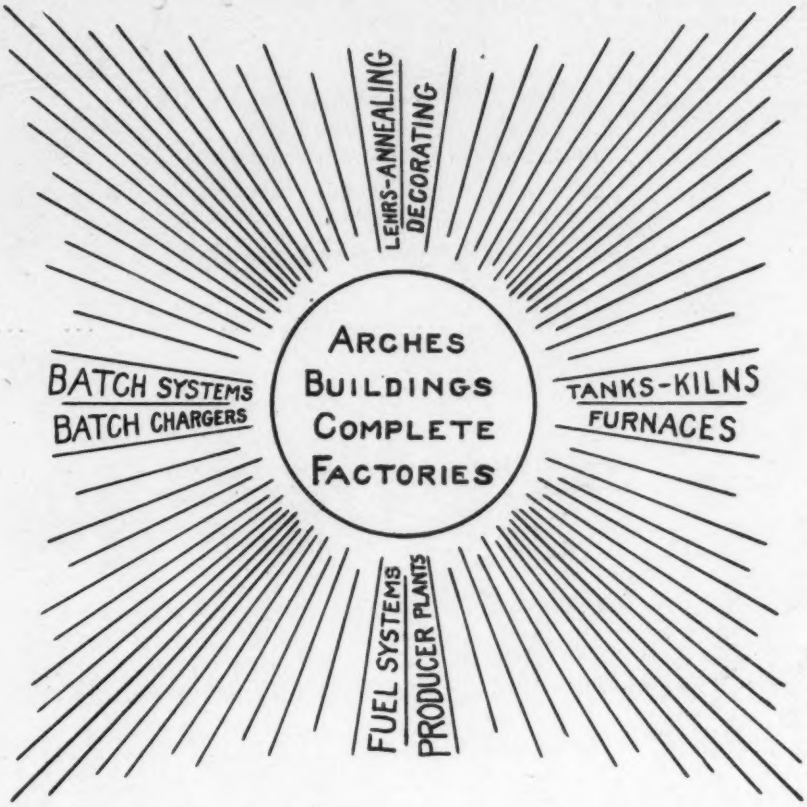

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the glass industry

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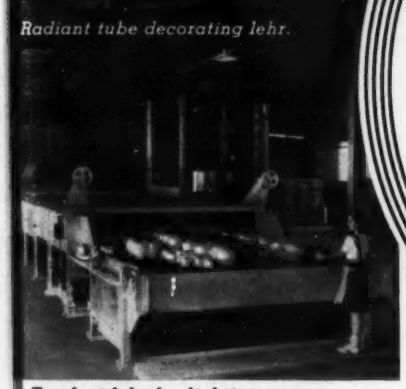
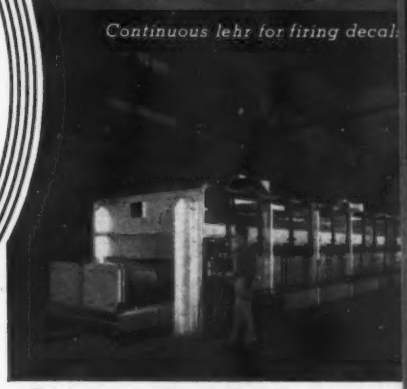


Ten foot lehr for lighting-ware.



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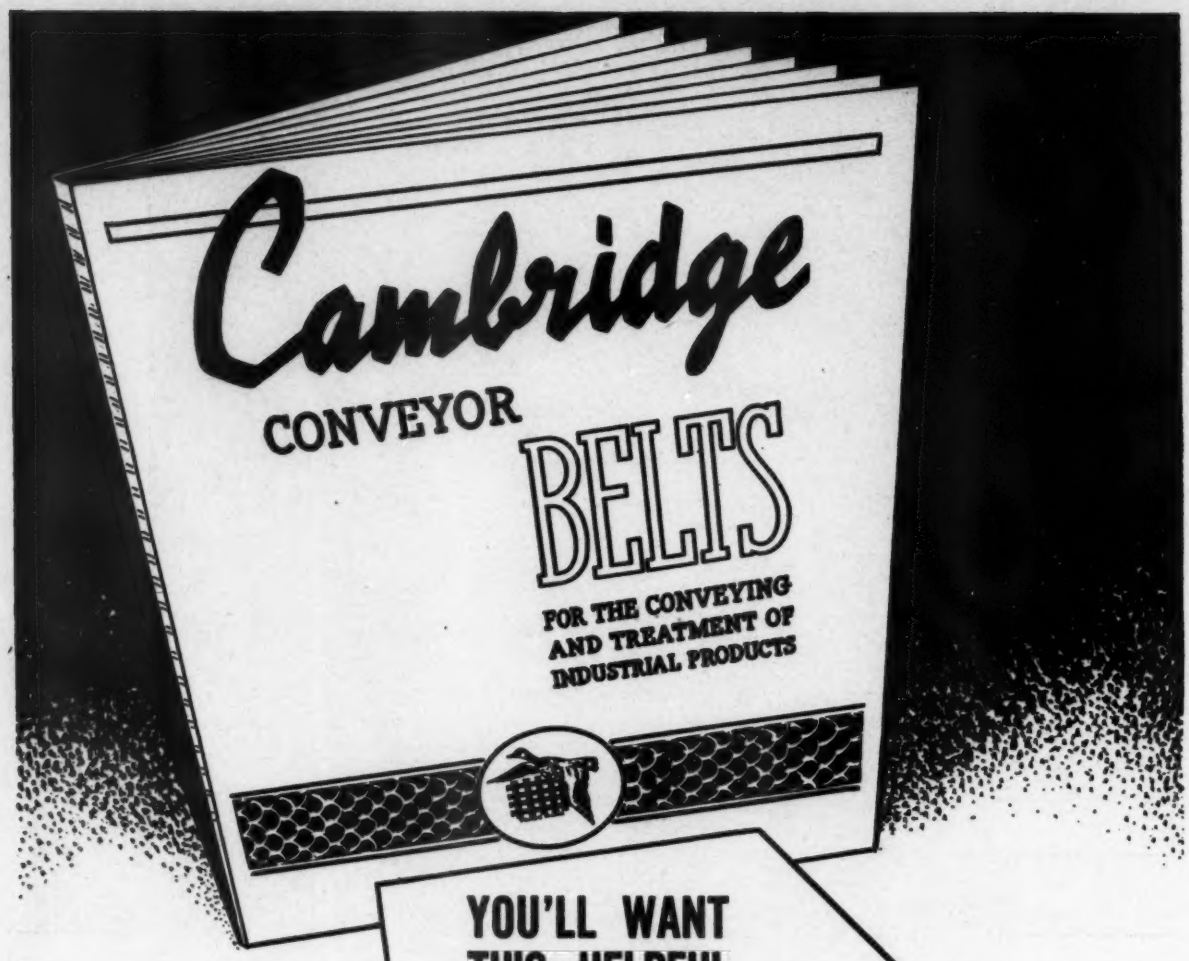

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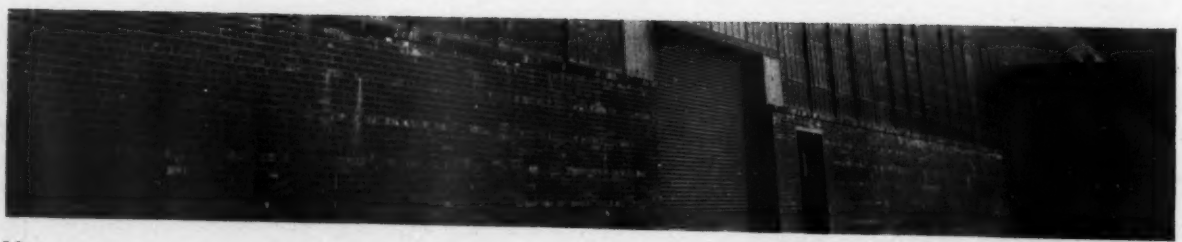


THE GLASS INDUSTRY

VOLUME 23, NUMBER 1, JANUARY, 1942

THE POLARISCOPE AS A GLASS FACTORY INSTRUMENT

By V. C. SWICKER*

The polariscope, an instrument for revealing strain in glassware, is used to determine whether or not the degree of annealing, i.e., the temper of the ware, is commercially satisfactory. It consists, chiefly, of a light source, a polarizer, a sensitive tint plate, and an analyzer. In the latest type polariscope, both the analyzer and the polarizer are made up of Polaroid screens which consist of a fixed suspension of certain crystals in the form of a polarizing film sandwiched between protecting plates either of glass or plastic. This film, which may be had in large sheets, replaces the earlier types of polarizers, and affords a large, uniform field. It is not appreciably affected by age, light or moderate temperatures.

A recent model Polariod polariscope is shown in Figure 1. This instrument is mounted for use in either the horizontal or vertical position. It may be used with, or without, the sensitive tint plate which can be swung in or out on hinges located immediately under the eyepiece. Uncolored ("flint") glassware is usually examined with the sensitive tint plate in place, but colored glasses are often more readily examined with the sensitive tint plate swung out of the field, thus giving a dark background. Very highly strained flint ware may also be examined advantageously under these conditions. This type of modern polariscope is gradually replacing the older forms, so that now the progressive glass factories have much better facilities for examining bottles for strain than were available in the past.

It is not our intention to write a highly technical description of the polariscope, its functions and uses, but we believe that a resumé of the uses of such an instrument in the glass plant may be of interest to foremen and inspectors who are responsible for quality control.

The Colors Seen in the Polariscope

A thoroughly annealed strip of glass, when examined edgewise in the polariscope field (without sensitive tint plate), remains dark and colorless against the dark background.

When the glass is put in strain, however, as by bending with the fingers, light begins to appear through it. First a dim illumination appears, which then becomes brighter and brighter as the bending increases. Finally colors begin to appear, first an orange shade, then red and purple followed quickly by blue. If the bending keeps on increasing, the blue turns to green, then yellow, then orange and red again as before. Furthermore, the thicker the glass is in the direction of view, i.e. the more glass the light passes through, the more color will be seen for a given amount of bending. This is important in relation to thick and thin walled ware, because due to its thickness a heavy weight bottle may show more color while actually having less strain than a thin, light one.

The colors keep repeating in this way, getting a little paler at each repetition, as the bending increases. Each repetition is called an "order" because the brilliance and purity of the colors in any one group seems to be about the same. The first order, however, begins with darkness and ends in reddish purple. The second order begins with blue and goes through green, yellow, orange, and ends with red which merges into the blue beginning the third order, and so on.

Fig. 1. Polaroid Polariscope.

*Hartford-Empire Company.

Fig. 2. One Standard Strain Disc as Seen in the Polariscopic Field. (Temper No. 1)

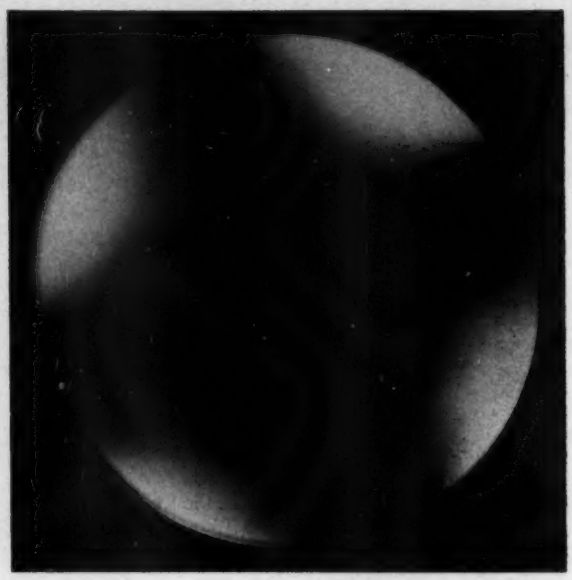


Fig. 3. Three Standard Strain Discs as Seen in the Polariscopic Field. (Temper No. 3)

It is not very often that second order colors are encountered in glassware except when the sensitive tint plate is used. This plate is simply a means of causing the progression of colors to start with the reddish purple lying between the red of the first order and the blue of the second order, instead of starting with the neutral grays occurring at the beginning of the first order. When the sensitive tint is used, very small changes in strain will accomplish the change either to red or to blue, producing strongly contrasting colors. By this means any moderately strained piece of glass, although incapable by itself of causing more than a small change in the shades of gray found at the lower end of the first order, will show a contrasting color effect that is much easier to see. This optical effect may readily be seen by flexing a strip of glass in the field of view.

The colors in the second order are the same as in the first order but are slightly faded by mixture with white light. The same series of colors is repeated in the third order except that they appear still more washed out. In the fourth order the colors are even less distinct, and above the fifth there is a transition to tinted whites. When the sample being inspected with the tint plate shows one or more of the orders higher than the second, it is an indication of very high strain.

When a piece of strained glass is examined in the polariscope the colors form definite patterns indicating the kind and amount of strain present. From these patterns it is possible to distinguish between areas of tension and compression, and so to discern the stress distribution throughout the sample. For example, if a broken ring section is held in the field so that the light passes through it parallel to the bottle wall, the effects of tension and compression may be readily demonstrated. If the section is bent in the direction to straighten it, tension occurs on the inner surface and compression on the outer. The contrasting colors so produced are clearly seen.

Measurement of the strains can be accomplished by use of a quartz wedge. As seen alone in the polariscope the wedge shows all of the colors as bands lying crosswise. One of these bands, corresponding to zero, is black and is called the index line. When a piece of strained glass is introduced in line of sight with the wedge the bands are seen to be moved by an amount depending on the strain in the glass. With suitable equipment this displacement can be measured, and from such measurements the strain in the glass may be estimated.

There are several distinct methods of applying the polariscope to the examination of glassware. In addition to being used in the form shown in Figure 1 for examining bottles or other glassware for temper or strain remaining after passing through the lehr, it may be used in several other ways about to be described. These are modifications of the basic method, not separate methods as set up in this text.

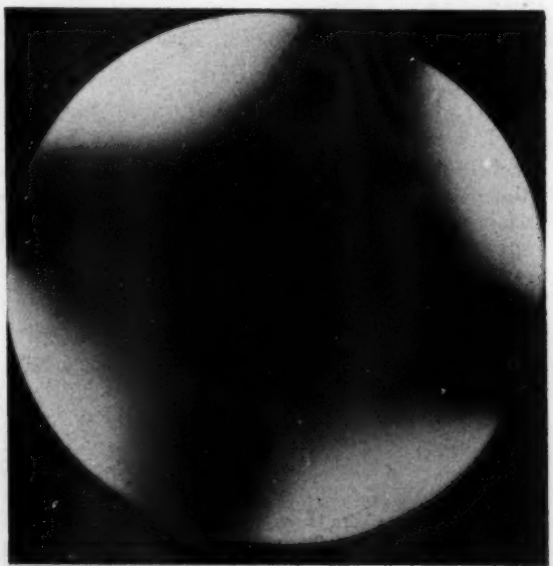


Fig. 4. Five Standard Strain Discs as Seen in the Polariscopic Field. (Temper No. 5)

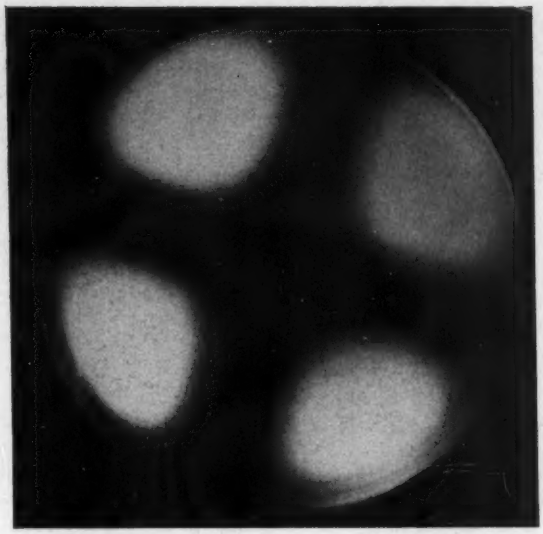


Fig. 5. Fifteen Standard Strain Discs as Seen in the Polariscopic Field. (Temper No. 15)

(1) The "Black and White" Polariscope

The "black and white" polariscope, which is obtained by removal of the sensitive tint plate, is sometimes useful. Examination of "flint" bottles by this method is not usually as satisfactory as when the polariscope has a sensitive tint field. It is frequently used, however, for the examination of dark colored bottles or where the strain in flint containers exceeds certain limits as described below. In such cases the width of the lines making up the black cross pattern in the bottom is an indication of the amount of strain present. Narrow lines indicate high strain.

Figures 2, 3, 4 and 5 show this particular type of strain pattern. Figure 2 is typical of low strains and corresponds to Temper No. 1. (Measurement of temper is explained below in discussion of G.C.A. annealing standards.) Figures 3 and 4 show patterns corresponding to three and five times as much strain as in Figure 2, and Figure 5 shows the pattern when high strains are present. The last three photographs show the characteristic narrowing of the lines.

(2) The Immersion Polariscope

The immersion polariscope is used by some manufacturers for checking up on the degree of annealing by examining the article submerged in a glass cell containing monochlorbenzene or a similar liquid capable of greatly reducing the reflection and refraction of light by the glass. In this type of examination the bottles are inspected by looking through the thickest parts of the side wall and base from the side, as well as by looking down through the neck. This method of inspection is particularly applicable to odd-shaped articles, due to the fact that the bulk of the surface reflections are eliminated.

(3) The Quartz Wedge Compensator

In special cases it is sometimes desirable to determine the amount and kind of strain in a glass article. Such determinations, however, require specialized equipment which, if available, may yield results of great value. For instance, if a polarizing microscope is available, or microscopic equipment such as shown in Figure 13 for ring section examination, an eyepiece carrying a quartz wedge may be used. With this, the effect of strain in the sample upon the position of the index line of the wedge may be measured, thus giving the value of the strain. In some instances it has been found desirable to build a special polariscope by which the lines shown by the wedge are projected on a screen. Such units have proved useful in minimizing breakage troubles and manufacturing losses arising from poor annealing. The graduated quartz wedges which are used in such special equipment may be purchased from manufacturers of optical instruments.

Figures 6 and 7 are illustrative of this method of measuring strain in glass. In Figure 6 the dark band, or index line, extends straight across the sample, showing that no appreciable amount of strain is present. Figure 7 shows an angular displacement of the band indicating considerable strain. If this band is viewed in conjunction with a scale, which can be either on the wedge itself, or on the screen, the strains may be measured.

Standardized Inspection with the Polariscope

Until about four years ago, grading bottles for annealing had not been standardized and there was no general agreement on annealing classification. A system set up many years ago by the Hartford-Empire Company for classifying the degree of annealing was being used to good advantage, however, in a large number of factories. This system, which used an "A-B-C" scale, was based on the progression of colors shown by increasing amounts of strain. Its disadvantages lay in the variation between polariscopes whereby the shade of color corresponding to a particular strain would appear different to different observers or with different instruments.

Such discrepancies could be avoided by comparing the ware to be graded with samples standardized at known values. In this way, although their appearance may change from one polariscope to another, the relation between the standardized samples and the ware remains the same. This is the purpose of the "standardized disc" system which was adopted early in 1938 by the Glass Container Association of America, and accepted as a standard

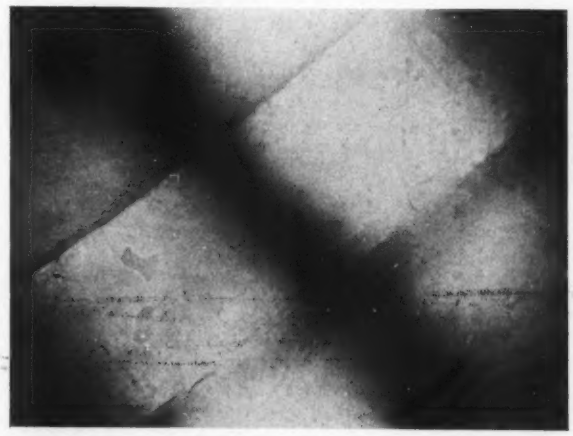


Fig. 6. Thoroughly annealed glass as seen in a polarizing microscope fitted with a quartz wedge. The Index Line within the glass is continuous with that in the field.

Fig. 7. Glass strained by bending as seen in the polariscope fitted with a quartz wedge. Note the displacement of the Index Line within the glass, and the first order bands appearing at either side of the Index Line in the corners of the picture.

procedure by the American Society for Testing Materials (A.S.T.M. Specification C148-40T). The present standards, which were developed in the laboratories of the Hartford-Empire Company in collaboration with the Glass Container Association Technical Standards Committee, are being used by practically all bottle manufacturers throughout the United States.

Each set of "Annealing Standards" consists of five discs mounted in an aluminum holder, as shown in Figure 8. The individual discs are all strained to the same degree, and can, therefore, be used interchangeably.

The procedure for grading glassware with the standard discs involves an important precaution. This precaution is to remember that the nearest match is not what is wanted. On the contrary the object is to determine the least number of discs which will show a total strain exceeding that in the ware. That number of discs is the temper number of the ware. If the strain in the ware is even slightly greater than that shown by any particular number of discs, then the temper number of the ware is likewise greater.

The following instructions are etched on the holder of each set of discs:

No. 1 Temper—Less than 1 disc.
No. 2 Temper—Less than 2, greater than 1.
No. 3 Temper—Less than 3, greater than 2.
No. 4 Temper—Less than 4, greater than 3.
No. 5 Temper—Less than 5, greater than 4.
No. 6 Temper—..... greater than 5.

The term "temper" was adopted as providing a short expression to designate the strain remaining after annealing, and furthermore to carry a suggestion of the known fact that for glassware absolutely dead annealing would not be as practical as some slight "temper."

This classification system has proved to be very satisfactory for determining the temper of flint bottles. The discs may be used with all types of strain-viewers, and the comparison is simple and trustworthy. This method minimizes the variations between individual interpretations of the previous standards, and supplies the industry with a unified method of strain comparison.

For the examination of amber, blue, and green bottles, this system of grading is not entirely adequate because no ready compensation can be made for the differences in the colors being compared. Some factories, consequently, continue to use an alphabetical classification, and others have provided their laboratories with well-annealed colored discs of the same size as the standard discs, and made from the particular color of glass to be examined. This colored disc is used as a color filter in conjunction with the standards.

When no suitable color filter is available a good evaluation can be obtained by removing the tint plate and using the black "cross" as the means of comparison (shown in Figures 2 to 5).

Handling Bottles in the Polariscope

The correct position in which to hold the sample varies with the type of polariscope. With the older type instruments, the bottles were usually held in one of the two "corner-to-corner" positions if the side walls were to be examined. In the case of the polariscope shown in Figure 1, the bottles must be held horizontally or vertically, but not in the 45° position. If there is any doubt as to the correct position, a moderately strained bottle should be placed in the inspection field and the positions of maximum color intensity determined. There are two such positions of maximum color intensity and they are always 90° apart. Bottles may be examined in either of these positions, but it must be recognized that the colors in one position will be the exact reverse of those in the other position. To avoid confusion, all samples should be held in the same position. For inspecting the bottom, the bottle is held so that the bottom can be viewed down through the neck. Both the side wall and the bottom should always be examined.

Distinguishing Cords with the Polariscope

In using the polariscope it is necessary to distinguish between: (1) strains set up by cords, and (2) those remaining after lehring. Glass that is free from strain will appear the same as the background. However, when the glass is strained, bands or areas of color show up, varying in intensity with the amount and kind of strain present.

Fig. 8. Set of Standard Strain Discs, issued by Glass Container Association.

Fig. 9. Vertical cords in a bottle as seen in the polariscope.

Fig. 10. Heavy cords in a cross section of a bottle as shown by the polariscope.

Fig. 11. Light cords in cross section as shown by the polariscope.

In glass that is free from obvious cords, annealing strains, i.e. strains remaining after lehring, appear in the bottle as wide bands or areas color. When the strain is high, the pattern in the bottom of a round bottle assumes the shape of a cross. With the sensitive tint plate moderate strains appear as reddish yellow or as bluish green; high strains more nearly approach a light yellow or light green. Intense strains show up as colors of a higher order.

When the glass is "cordy," however, narrow streaks of color may appear in both the side wall and in the bottom. Horizontal colored streaks may be seen in the extreme lower side wall and vertical streaks in the upper side wall and neck, depending upon the manner in which the glass flowed during the forming process. The intensity of the streaks of color will depend on the size and nature of the cords[1] Therefore, when bottles are rated for annealing, a distinction must be made between strain caused by cords and strain remaining after annealing. Whenever during the course of inspection, the narrow streaks caused by cords first appear, or show an increase in intensity, these facts should be called to the attention of the superintendent, and ring section examination should be promptly made in order to obtain a truer evaluation of the quality of the glass. It must be recognized that the usual polariscopic examination, by itself, is seldom adequate to evaluate the homogeneity or cordiness of the glass.

The narrow streaks of color that are sometimes seen in bottles are generally caused by cords. Figure 9, which is a photograph of the shoulder of a very cordy beer bottle, shows these typical streaks. Such heavy cords, extending the length of the bottle, may lower the strength of the container appreciably. Figure 10 is a cross-sectional view of a localized heavy cord such as is occasionally found in cordy bottles. This view may be seen by examining a ring section under the polarizing microscope.

A cross-sectional view of a typical localized light cord is shown in Figure 11. This type of defect is caused by cords of minor intensity, which because of their irregular shape often fold-over, thereby causing a multiple thickness of the original cord. Where this occurs, vertical streaks of color show up when the bottle is examined in the polariscope.

Stones or inclusions in the glass are often surrounded by regions of high strain localized to a small area in which the foreign particle is embedded. Figure 12 is an illustration of this type of defect. Glassware containing such stones should be discarded.

Manufacturers should determine for each kind of ware just what limits for "Temper" and cords are required to insure satisfactory service. These limits will frequently differ from one type of container to another. They will, generally speaking, be higher for thicker walled ware. In such ware, because of the thickness of the glass, the color is higher for an acceptable amount of strain than in thin ware. The limits will also naturally depend upon the structure of the bottles and upon the manufacturer's

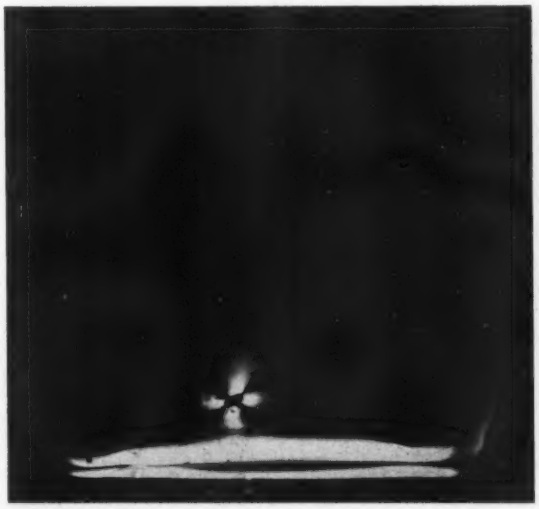


Fig. 12. Stone in the lower side wall of a bottle. Viewed through the polariscope.

Fig. 13. Polariscope equipped with accessories for Ring Section Examination.

previous experience with the performance of similar ware in service.

The examination of ring sections for homogeneity may be carried out using the modern polariscope, thereby providing a means of glass quality control. Accessories including a simple microscope and an immersion cell, must be used with the polariscope to accomplish this purpose. (Figure 13 shows these accessories mounted on a polariscope.) The procedure is about the same as that required when the ring sections[2] are examined with the polarizing microscope. This type of examination, which gives a good picture of the quality of the glass, is being used extensively throughout the industry as a means of quality control. It is based on the examination of containers in cross-section, and consequently gives a different picture of the homogeneity of the glass than is obtained when the bottle is examined in the usual way.

For production quality control, bottles should be taken from each mold for polariscopic examination at least every three hours. Some factories go so far as to make hourly tests. The samples, which should include bottles both from the sides and the center of the lehr, must be allowed to come to room temperature before inspection. Additional samples should be taken just after "breaks" or spaces on the lehr belt. At such places a number of rows of bottles may be too highly strained to pack. The method of sampling, and the testing procedure, should comply with the instructions detailed in the "Standard Testing Procedure Manual" which was distributed in 1938 to all bottle manufacturers by the Glass Container Association of America.

The polariscope should be located near the end of the lehrs in a fairly dark place, or shielded from extraneous light. It should be readily accessible to the inspectors, who should be familiar with its structure and how to use it, if the maximum benefits are to be obtained.

The polariscope is an indispensable instrument in the glass factory. It is a necessity for checking up on the performance of the lehrs and on the annealing of the finished product. Indeed, it is one of the pieces of testing equipment which every bottle factory needs in order to meet the requirements of the Glass Container Association Standard Testing Procedure. It is a "must" in every well operated glass plant.

The author wishes to express his deep appreciation for the helpful advice and generous assistance of Mr. T. D. Green of the Hartford-Empire Laboratory in the preparation of this paper. He is also indebted to Mr. George Blessing of this laboratory for the photographs of strained glass used here, and to the Polarizing Equipment Co. for Figures 1 and 13.

[1]The effects of a cord are visible in the polariscope because the cord has somewhat different composition from the mass of glass in which it lies. This results in relatively large strains in the cord and the adjacent glass.

[2]V. C. Swicker, "Ring Section Examination of Glass Containers," Bul. Amer. Cer. Soc. 18 (4) 143-147 (1939).

HOWARD S. EVANS

Howard Salisbury Evans, aged 65, died of a heart attack at his home, Pittsburgh, Pa., on the morning of December 14. The deceased had spent the greater part of his business career in the glass manufacturing industry. Mr. Evans' first association with the glass industry was when he entered the employ of the Thomas Evans Company, of which his father was president. When the Evans and MacBeth interests were merged into the MacBeth-Evans Glass Company in 1899, Mr. Howard S. Evans became associated with that firm. Mr. George A. MacBeth was its president and Mr. Thomas Evans, vice president and treasurer. Thomas Evans succeeded Mr. George A. MacBeth as president of the company at the time of the latter's death in 1916. Mr. Thomas Evans died on December 8, 1923, and Howard S. Evans, then vice president of the company, was elected to succeed his father as president. Mr. Evans continued as president until 1926 when he retired and Mr. George D. MacBeth was elected president of the company.

Howard S. Evans was also one of the founders of the Diamond Alkali Company of Pittsburgh and a member of its board of directors. Since his retirement from the glass manufacturing industry he maintained offices in the First National Bank Building, Pittsburgh, where he was active in many lines of enterprise.

NEW COMPTROLLER FOR PPG

The naming of Stuart M. Campbell of Chicago as comptroller of the Pittsburgh Plate Glass Company was announced December 23 by R. L. Clause, president of the company. He assumed his new duties January 1. Mr. Campbell has been with a Chicago accountancy firm since 1922.

Mr. Campbell will succeed M. C. Spahr, who will retire next year after more than 50 years of continuous service with Pittsburgh Plate Glass Company. He will remain with the company during 1942 in an advisory capacity.

• The Corning Glass Works announced December 3 the appointment of John W. Romig as manager of the Pressware Division and Thomas S. Wood, Jr. as assistant sales manager of the Bulb and Tubing Division. The appointments were effective December 15.

THE TOLEDO TRIAL

The Hartford-Empire Co. had only one witness remaining to complete its defense in Federal Court in Toledo, Ohio, when the trial recessed for the Christmas holidays, Dec. 19. That witness, expected to be on the stand for direct examination for at least three days, following the resumption of court, Jan. 5, is Col. R. D. Brown, patent counsel for Hartford for many years.

Judge Frank L. Kloeb, anxious to see the trial concluded, instructed counsel for the Owens-Illinois Glass Co. to have its witnesses ready for hearing immediately upon conclusion of Hartford's case. Henry Middleton, chief of the Owens' counsel, said his company's defense would be brief. Following Owens will come the defense of the Ball Bros. Co.

Actual testimony in the trial began March 3, 1941, and Judge Kloeb advised counsel before dismissing them for the holidays that he would like to see it concluded not later than Jan. 16. The attorneys expressed doubt that this will be possible but promised to speed up the case as much as possible.

Shortly before the Christmas recess was called Sidney F. Parham, one of Hartford counsels, threw the courtroom into an uproar when he advised the court that he has ordered from the U.S. Patent Office the complete files on 138 patent interferences and wanted them brought into court as defense exhibits. Samuel S. Isseks, chief government counsel, objected strenuously, declaring that the files on the 138 interferences weighed 2,700 pounds. He kept insisting that he would not agree to the submission of more than a ton of evidence.

Parham and James Carlisle, the youngest attorney in the defense set-up, made several proposals but Isseks refused them. They proposed having the record show the interference files as exhibits without actually being brought into the courtroom and Isseks said he would not consent to the admission of any exhibit without examining it. Judge Kloeb told Mr. Isseks he would have to reach some agreement with defense counsel on the exhibits or he, the judge, would permit the ton of papers to be brought to court. He advised both defense and government counsel to reach an agreement during the holidays.

During a recess which followed the tonnage discussion one defense lawyer remarked that "Isseks isn't concerned so much with the admissibility as with the weight of the evidence."

The government had contended early in the trial that there had been frequent interferences in the Hartford patents and that Hartford had delayed the hearings on them to stifle competition. Mr. Parham insisted that the delays were no fault of Hartford's and said introduction of the patent files would prove his claim.

The pre-holiday court sessions saw Vernon M. Dorsey, former patent counsel for Hartford, recalled to the stand for the third time to testify to various points of patent procedure and the workings of certain glass manufacturing devices.

Hartford spent $25,000 for a survey of the glass business in preparation for the Toledo trial, according to the testimony of Dr. Ralph C. Eppstein, consultant on economics and professor in the University of Buffalo. He was a witness for Hartford and testified from large prepared charts as to the growth of the glass container business. Dr. Eppstein, on the stand for two days, testified that the "Big Four" in the glass container industry are the Hazel-Atlas Co., Owens-Illinois Glass Co., Ball Bros., and the Thatcher Glass Co. He said that in 1929 a group of smaller companies did approximately 12 per cent of the glass container business while the big four did 58 per cent. Ten years later, in 1939, the group of smaller firms had increased their business to 21 per cent while the big four dropped to 55 per cent, he said.

His testimony drew considerable objection from the government counsel, based principally upon his admission that he surveyed only certain companies and not all glass container manufacturers. The defense submitted an outline of nine subjects which Dr. Eppstein was to testify to but Judge Kloeb limited his testimony to four of the points. These included the general questions of whether small firms gained or lost importance during the depression period; whether competition between the glass container manufacturers prevailed; whether the business of the smaller firms licensed by Hartford-Empire increased or decreased in comparison to the larger companies which were similarly licensed, and whether the profits of the Hartford-Empire Co. were out of line with those of other manufacturing companies in general.

During cross examination Dr. Eppstein admitted he was paid $25,000 to make the survey of the industry for court presentation and said at the time he was retained he was told by John Lord O'Brien, then counsel for the Corning Glass and now general counsel for the Office of Production Management, the purpose of the survey. Dr. Eppstein said the $25,000, which was a rough figure, included the salaries for assistants and all expenses incident to the survey. He paid his assistants, some of whom were on the faculty of the University of Buffalo, something between $5,000 and $7,000, he said.

Dr. Eugene C. Sullivan, Corning, N. Y., broke the monotony of the trial with his testimony and description of glass shrinking. After describing the principal types of glass manufactured by Corning, party to the suit principally because of its stock ownership in Hartford, Dr. Sullivan described some of the purposes for which special types of glass had been perfected in the Corning laboratories. One set of lenses, one of its most famous wares, is used in the "tenderizing" of meat; another sort of glass will permit the passage of rays that will kill germs, he said, and others will resist heat and chemical action.

Two flat glass dishes, on the order of low casseroles, were introduced in evidence. They were identical in shape but one was about half again as large as the other. Dr. Sullivan said the smaller one was made from another like the big one, through a shrinking process which includes heat treatment and chemical applications. The resulting small casserole would resist great temperature changes, he said, because it had a co-efficient of expansion only about one-twelfth that of ordinary glass.

Two models of formers and feeders and a polariscope were introduced as defense exhibits to acquaint Judge Kloeb with their method of operation. While no actual demonstration of formers and feeders was possible, for the polariscope exhibit the courtroom was darkened and the Judge was provided with polarized spectacles.

HARMONIC VIBRATION BREAKING POINT OF GLASS

By E. L. HETTINGER
Willson Products, Inc.
Reading, Pa.

In the development of industrial eye protection, it was necessary to produce a heat treated glass that would withstand a certain amount of impact. Since this impact came from an unknown angle, without warning, and with the hardness of the projectile, the velocity, the size, and the shape, also unknown, it was essential to give serious thought and study to the fracture characteristics of glass. It had to be a glass that would not explode when struck and blow the eye out of the socket, and over a period of 25 years' experiment and experience we have come to the point where we can call glass "supertoughened" or "heat treated."

The early processes of heat treating glass, or hardening as they called it in 1879, were developed by Siemans, LeBastie and Piper. LeBastie's method was given very careful consideration and in a description of his procedure, appearing in Lippincotts's magazine in 1879, he assumed "that the cohesive weakness of its molecules caused the fragility of glass and that if the molecules could be forced closer together the strength of the material would be increased." Siemans experimented along the same line, while Piper's method consisted of heating glass to almost the point of platicity and then subjecting it to the action of an injection of superheated steam. These early inventors did not seem to consider the photoelastic properties of glass but simply strove to make it hard, so that when it broke the particles somewhat resembled a Prince Rupert's Drop. We know from experience that there is quite a difference between shock value and hardness value. All the earlier translations of glass processes along these lines used the word "hard" and an article on the misuse of this word as applied to heat treated glass, written by Prausnitz and Berger (Jena), is well worth reading.

All of this work naturally meant conducting tests to determine the strength of the glass, or its resistance to impact as it may also be termed, and in all these tests, which covered the breaking of thousands of pieces of glass, a pattern (or whatever you wish to call it) of an harmonic nature always presented itself. Weld's Glossary of Physics states that an "harmonic" is "an overtone or partial bearing a simple frequency ratio to the fundamental." It has been said that the pulsations in the breaking of glass, as shown by some of the photographs submitted, are somewhat similar to those of earthquake tremors recorded by seismograph. In Frocht's book on Photoelesticity* he says "a particle is said to have simple harmonic motion when it moves along a straight line and has at each instant an acceleration directed toward a fixed point on the line of motion and proportional to its distance from the fixed point." He states further, "the direction in which the disturbance travels is the direction of propagation. The velocity with which the disturbance advances is the velocity of propagation of the wave. It is assumed that the velocity of propagation is constant in one medium and is the same for all particles on the wave. The distance from one particle on the wave to the nearest particle having an equal displacement and velocity is defined as the wave length. It is the distance from crest to crest or trough to trough."

One of our tests consists in using a Carver Laboratory press with a ½-in. radius plunger (hardened steel). A 50 mm. heat treated lens is supported on a hollow steel block with an ⅛-in. ledge holding the lens on a thin

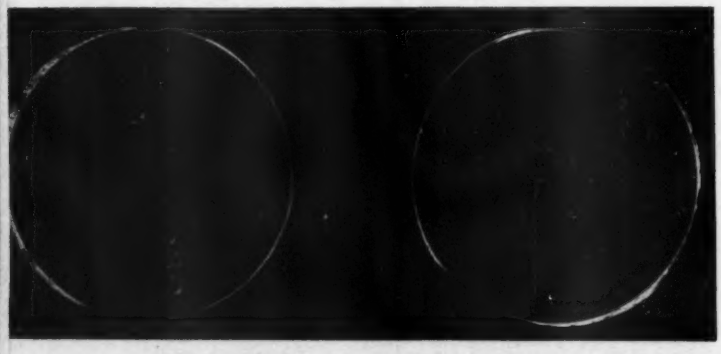


Fig. 1. These two lenses show the first stages of fracture. The tiny fractures were made with a small metal pointed tool, similar to a pick. The glass was held in the hand and just struck violently enough to mark as shown. This is the beginning of a fracture.

Fig. 2. An enlarged section of one of the lenses shown in Fig. 1. You can readily see the beginning of a cone or button which will be shown later.

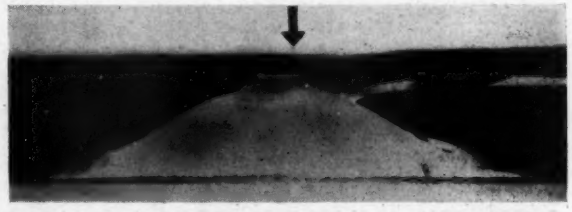


Fig. 3. Shows the contact at point of arrow and the light portion shows where the button was released.

Fig. 4. Shows black circle where a hole was drilled through the glass with a steel drill and the pressure exerted before cutting through to the opposite side was such that the whole back of the lens let go as shown by the miniature waves.

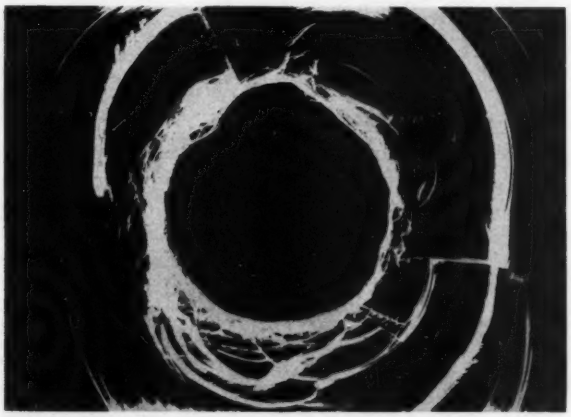


Fig. 5. This is a prescription lens with a cylindrical surface on one side and convex on the other and shows that curved lenses will not break outward as represented by inexperienced operators. This lens shows that the bottom or broken glass always goes in the direction of the force.

fiber washer. If the ratchet is pumped at the rate of say 50 strokes per minute you will have one breakage and at 100 or 150 strokes per minute with quick contact you will get a higher point of breakage. In other words, if the breakage contact is of slow speed you will record a low reading on the pressure gauge because the molecules may not be in harmonic vibration. If the test is repeated, using a lens from the same batch of glass, in fact from the same sheet of glass, and the quick pumping action is used instead of slow, the reading on the gauge may be two or three times higher. Our results on this test, spaced over a period of years, leads us to believe Dr. Preston's statement that "the true instantaneous strength of glass is infinite."

A blow pipe and the use of steel ballbearings or steel projectiles of small diameter, such as $\frac{3}{8}$-in. steel ball (52 grains), $\frac{1}{4}$-in. steel ball (15 grains), air rifle steel shot (4 grains), $\frac{3}{16}$-in. steel ball (6 grains), $\frac{7}{32}$-in. steel ball (11 grains), provides an excellent means of demonstrating forces. Since we are all more or less

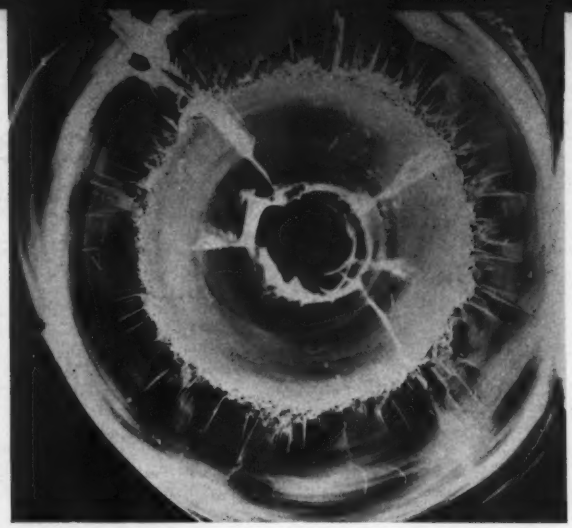


Fig. 6. Shows the bottom side of a piece of glass that had been struck with a small steel ball blown from a blow pipe. Note the circle is where the fracture started. Immediately circular wavelike motion was started until halfway between the center and the outside periphery of the lens, then the break looked as though it was going into radial, but it swung back to the circle. This in many ways looks like a pebble splashing in a quiet pool of water.

familiar with the operation of wind instruments, reed or brass, we can see that certain like pressures can be developed by using a blow pipe. It is easy for a musician to strike a certain note on his wind instrument and it is just as easy to duplicate fracture after fracture by means of a blow pipe, ballbearing or steel projectile. A blow pipe not less than 24 in. long, but not over 48 in. will do the job. Ordinary steel ballbearings will answer if your shop is not in position to turn up small steel projectiles not over $\frac{1}{4}$ in. or $\frac{3}{8}$ in. long. If you have projectiles turned up, it might be well to have various contact points turned up because you will be able to get very different and interesting results if the angles of the points vary. Always use a funnel shaped rubber shield on the discharge end of the pipe (to guard against possibility of flying particles and to catch the projectile) and protect your hands with suitable gloves.

To those of you who have access to an air tank with regulated control, you can readily duplicate your results with anywhere from 1 to 20 pounds pressure. I have found that even the large, heavy, portlight glasses can be broken with air pressure of 4 pounds, using a 4 ft. brass pipe and $\frac{3}{8}$" steel ballbearing.

It is presumed that the ball drop test as required by Federal specifications for testing lenses is sufficiently well known to make unnecessary detailed explanation. However, this test is referred to in one or two illustration captions.

The last photograph of the group submitted shows how a lens will break when fractured by a steel ball from an air rifle at a velocity of about 300 ft. per second. The fracture, or disturbing energy, started motion in the glass which began to vibrate in radial lines. Halfway between the point of contact and the outer edge of the lines is a circular fracture and from then on the lines are straight and continue in the same direction. Somewhere there are rhythmic or harmonic forces in action.

These photographs were not made from negatives but by placing the glass itself in the enlarger or projector and printing directly on the paper.

*Photoelasticity—Max M. Frocht—John Wiley & Sons, Inc., N. Y. C., 1941.

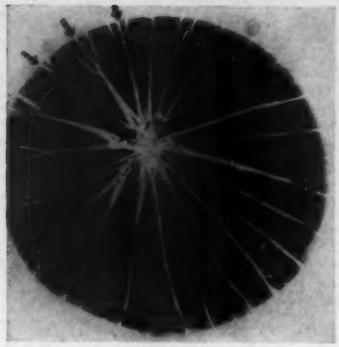


Fig. 7. This lens was broken on a Carver Laboratory Press. The glass was engaged or supported on a steel block (hollow) with a 1/8" ledge covered with a fiber gasket or washer. This lens broke at about 220 pounds pressure. When a break of the "V" or spearhead type, as shown by the arrows, occurs then the composition of the glass is not of the best for heat treatment.

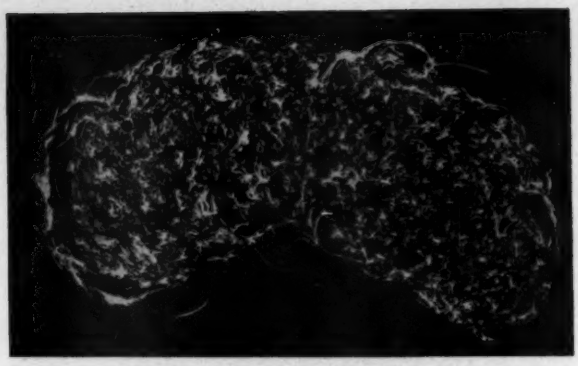
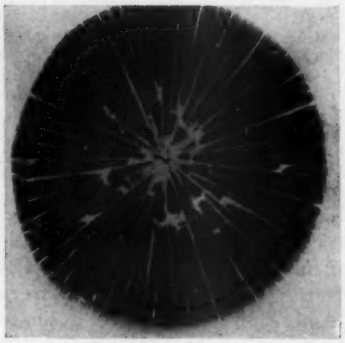


Fig. 9. Shows the result of a severe ball dropping test that was developed to test the real fatigue that might be encountered. The ordinary standard ball drop test is a 5/8" steel ball dropped from a height of 1 meter. So as to increase the force the ball was elevated to 76". Here the ball was dropped 1833 times with the surface varied so as to try to locate a weak spot.

Fig. 8. This shows a true radial break made in the same manner as Fig. 7. Skilled operators can soon tell if the glass is properly heat treated and of the right composition. The narrower and finer radial sections would indicate that this glass broke at about 700 pounds pressure exerted by the small steel plunger of the Carver Press.



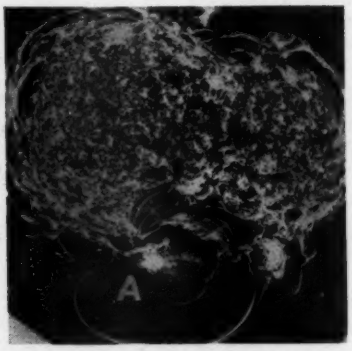


Fig. 10. 2279 blows on a concentrated area. At the point "A" you will note the vibration and wave motion with the lateral waves similar to those shown on Fig. 6.

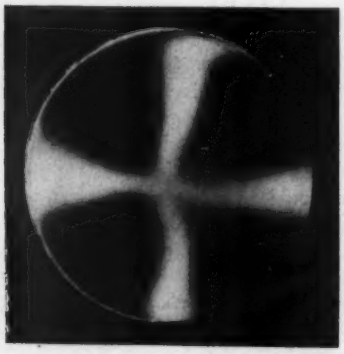


Fig. 8-A. Shows a heat treated lens 3.6 mm thick with a polarizing plate on one surface of the glass and another polarizing plate on the projection lens. A correctly heat treated piece of glass will show a lateral image when placed between polarizing plates.

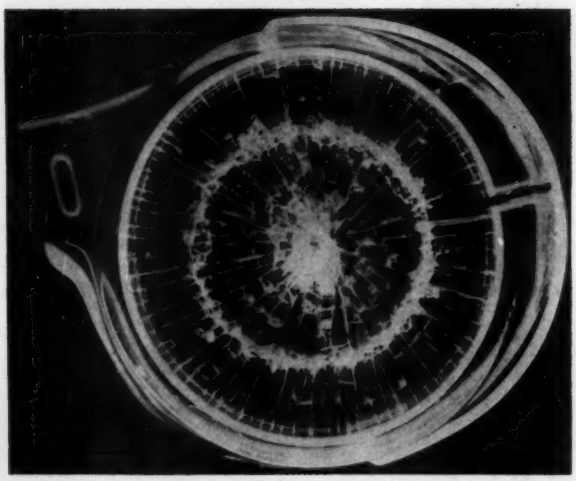


Fig. 11. Represents the final harmonic vibration breaking point of glass. This can be duplicated fifteen or twenty times out of a hundred. Evidently the lack of homogeneity of the glass itself or something in the heat treatment does not permit a higher average. Here the center of the glass was struck by a steel pellet from an ordinary air rifle and the force began to break the glass as shown. Just whether the circle develops before or after the radial fracture would have to be proven by high speed photography. In this instance none of the glass left either surface. Evidently there was an harmonic vibration of some kind that permitted the glass to come to a point of rest without losing its position in either surface. This lens was supported in a goggle cup in the position in which it is normally worn, when in actual use.

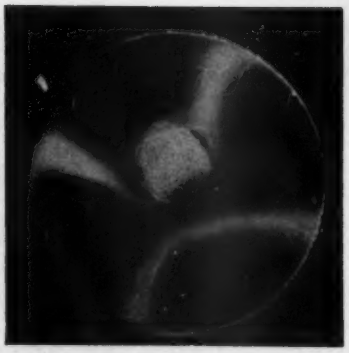
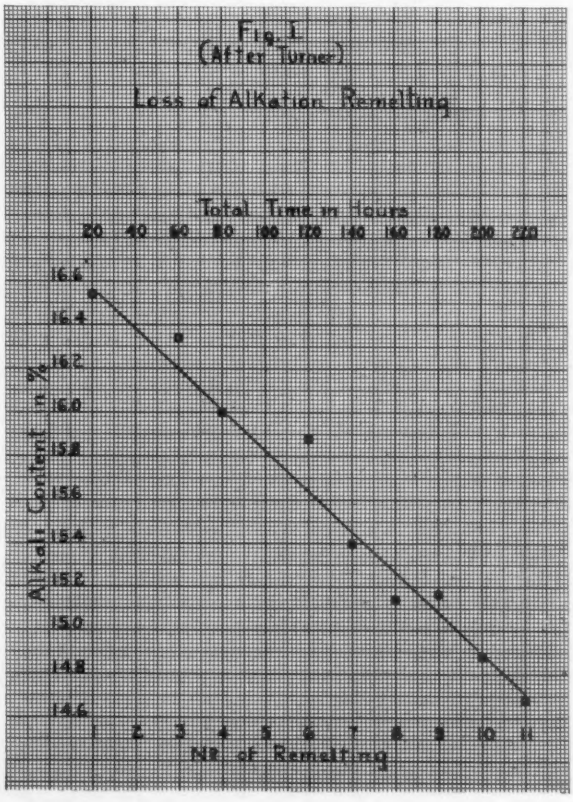


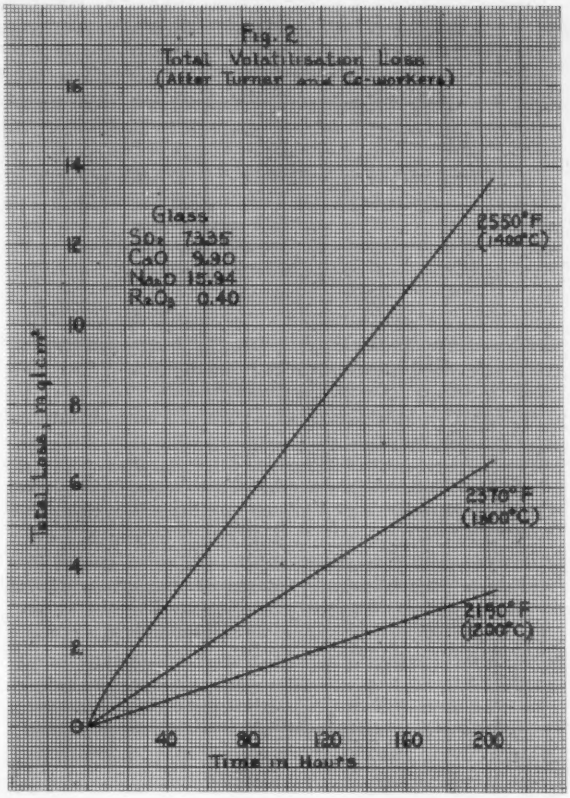
Fig. 8-B. A heat treated lens 4.1 mm thick which had been subjected to 6102 blows from a 5/8" steel ball at 76". Note the entire chipping effect is on one spot and the thickness was cut down to 2.6 mm at this point; 1.5 mm of the glass was cut away without the glass breaking. It shows the image of uniformity of the heat treatment and this may change the theory that when you cut below the surface of a heat treated glass it will fracture.

THE VOLATILIZATION OF SODA FROM SODA-LIME-SILICA GLASSES: A REVIEW

The problem of the volatilization of alkali from glass has been studied by various investigators (largely by Turner and his co-workers in England) mainly for the information that the subject might reveal concerning the nature and constitution of glass. Much of the information obtained, however, has been found to be applicable to practical glass-making. It is with this phase of the subject that this present review is concerned.

It is well known from observation that increases in the cullet content of a glass batch results in a glass that has different melting, fining and working properties. For example, when no cullet is used in the batch the glass is softer working but as the cullet ratio is increased the glass becomes stiffer and harder working. Many explanations have been offered to explain this abnormal behavior of cullet on remelting, Scholes[10] suggesting that both the elimination of dissolved gases and volatilization of the alkali when the glass is remelted may be responsible. Early work by Turner[1] and his co-workers in which a series of soda-lime-silica glasses were remelted in open sillimanite and fire clay pots (25 lb. capacity) at a temperature of 2550°F (1440°C) for 20-hour periods showed that even after correcting the chemical analysis results for the pot attack that the alkali content of the glass decreased as a result of eleven remeltings from 16.54 per cent to 15.27 per cent. The actual chemical composition (not corrected for pot solution) of the remelted glasses are shown in Table I. In Fig. I the relationship between





alkali content and the number of remeltings is shown graphically.

Further work was then undertaken by Turner and his co-workers[2, 3, 4, 5] on a more scientific basis. In these investigations small amounts of different composition glasses were placed in platinum capsules and heated in an electric furnace for various lengths of time and temperatures. From the data thus obtained the effect of time, temperature and surface area on the volatilization of the volatile constituents of the glasses was determined. Figure 2 shows graphically the effect of time and temperature on the volatilization of alkali from one of the soda-lime-silica glasses used by these investigators. The change in chemical composition of this glass before and after two remeltings is given in Table II. As the above glass was a pure soda-lime-silica glass which contained no sulphate an additional investigation was made on a soda-

TABLE I

Composition of a Soda-Lime-Silica Glass Prepared from Batch and Remelted Ten Times in a Sillimanite Pot (After Turner[1]).

Glass No.	SiO_2	R_2O_3	CaO	Na_2O	Total
827A	73.82	0.73	8.56	16.54	99.65
827C	73.94	0.85	8.63	16.35	99.77
827D	73.79	0.88	9.04	16.01	99.72
827F	73.74	1.32	8.90	15.88	99.84
827G	73.86	1.64	9.04	15.39	99.93
827H	73.90	2.04	8.84	15.14	99.92
827I	73.45	2.27	8.78	15.17	99.67
827J	73.59	2.42	8.83	14.89	99.73
827K	73.56	2.96	8.80	14.70	99.92

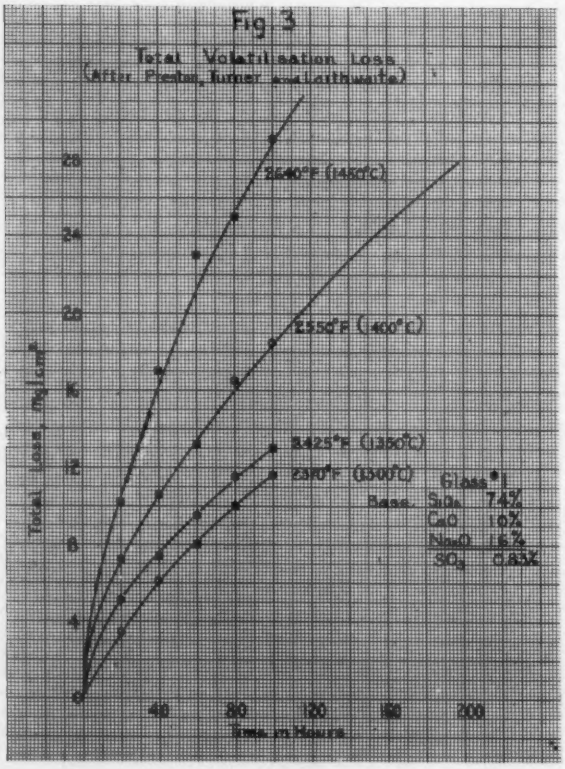
lime-silica glass in which a small amount of sulphate was present. The results obtained are shown graphically in Fig. III. It was found that the order of volatility was the order of the sulphate content and the loss of sulphate was approximately proportional to the initial sulphate content. In addition the presence of sulphate caused an increase in the loss of alkali approximately to the extent of twice the alkali volatilized from a pure glass of the same composition but containing no sulphate.

TABLE II

Chemical Composition Before and After Heating.

Temp.	Time	SiO_2	CaO	Na_2O
Original glass		73.35	9.90	15.94
1400°C	180 hrs.	75.04	10.10	13.74
1200°C	150 hrs.	73.42	9.88	15.73

As a result of these various researches Turner states, "The loss of any volatile constituent is proportional to the area of the surface exposed and its concentration in the surface layer. The rate of loss falls off with time, owing to the progressive change in concentration in the surface layer; but this change in rate is modified in turn by the rate of diffusion of the constituent from the lower to the upper layer, so that the depth, density and the viscosity of the glass have to be taken into account." Practically speaking it would seem that this volatilization loss should be constant for any given set of conditions and therefore could be neglected in practice. However, conditions are usually not constant in practice, the furnace temperature, furnace pull and cullet ratio are often varied. If then, glass of a specified composition and working properties is desired these volatilization losses must be taken into account.



Practical workers have estimated by experience the amount of alkali that must be added to the batch to account for the volatilization losses. According to Felsner[6] glass or remelting loses from 2-3 per cent of the weight of glass as alkalies so that if cullet is to be remelted alone it is necessary to add 2-3½ parts of soda ash to every 100 parts of cullet if the glass composition is to be maintained. Hodkin, Turner and Winks[7] found that the addition of 1 part soda ash per 99 parts of cullet resulted in a glass that worked exactly similar to the glass prepared from batch alone. Gould and Hampton[8] in their paper on the "Calculation of Glass Compositions from the Batch" showed that due to pot attack and alkali volatilization the finished glass is never exactly the same in composition as the glass calculated from the batch used. Gould and Hampton gave the following figures for the percentage loss of alkali oxides from a melt, per 1 per cent of the oxide in the batch, Na_2O (as soda ash) 0.032, (as saltcake) 0.06 and K_2O, 0.12. In the questionnaire on the use of cullet read at the Third Conference on Glass Problems held at the University of Illinois[9] in 1935 twenty per cent of the replies to the question "Do you consider it advisable to increase the amount of alkali in the batch if the cullet to batch rate is increased?" advised an increase in alkali. No set amount of alkali was suggested, the addition of alkali being made in small amounts until the desired working properties of the glass were obtained.

It can readily be seen from the results of these various workers that a definite correction factor that would take care of all conditions is an impossibility. From a practical viewpoint the best method of controlling the volatilization losses encountered in actual operation seems to be through the use of routine chemical analysis and physical property tests such as density determinations. In this manner the composition changes are quickly noted and prompt batch adjustments may be made. In addition, such data when coupled with operating data will in time allow estimates to be made of the effect various operating charges will have on the volatilization losses.

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[1]A. A. Childs, V. Dimbleby, H. W. Howes, W. E. S. Turner and F. Winks. Jour. Soc. Glass Tech., 1929, 13, 304.

[2]E. Preston and W. E. S. Turner, Jour. Soc. Glass Tech., 1932, 16, 219.

[3]Ibid., p. 331.

[4]H. W. Howes, H. Laithwaite, E. Preston and W. E. S. Turner, Jour. Soc. Glass Tech., 1935, 19, 104.

[5]E. Preston, W. E. S. Turner and H. Laithwaite, Jour. Soc. Glass Tech., 1936, 20, 127.

[6]E. Felsner, Ker. Rundschau, 1926, 34, 293.

[7]F. W. Hodkin, W. E. S. Turner and F. Winks, Jour. Soc. Glass Tech., 1929, 13, 47.

[8]Gould and Hampton, Glass Ind., 1930, 11, 249.

[9]Glass Industry, 1935, 16, 199.

[10]S. R. Scholes, Modern Glass Practice, p. 81 (1941). Revised Edition.

OPA ASKS FREEZING OF PRICES

A request to manufacturers in the household glassware group not to increase their current prices pending completion of further study, was made on December 19 by the Office of Price Administration at Washington. The OPA request, made by Leon Henderson, urged the household glassware group not to increase prices on current items above the levels prevailing on December 1, 1941, and to price new items at the same relative level.

THE FTC-ELASTI-GLASS HEARINGS

The Federal Trade Commission completed its case against the S. Buchsbaum & Co. of Chicago after four days of hearings before Trial Examiner C. A. Vilas on Saturday, December 13, in Washington, D. C. The FTC supported its contention with evidence from expert witnesses that men's accessories made from an organic material of glass-like appearance cannot properly be described as "glass" in any trade name entering interstate commerce. The date to resume the hearings in Chicago was tentatively set for February 2, when the respondent will present evidence in resistance to the FTC complaint.

The Commission's attorney, Eldon P. Schrup, contended that the S. Buchsbaum Company, in advertising its products implied that they were made of glass which he asserted they were not. Mr. Schrup also said that the company claimed its products to have properties associated with glass, such as durability and imperviousness to water or moisture. It was argued that the articles of men's accessories which the company manufactures from Vinylite contains no glass whatsoever, because the product known as Vinylite is not a glass but rather is a product made by the heating and mixing of petroleum or coal and salt with a special catalytic agent and chemicals to induce the formation of certain gasses and distillates, which in cooling results in a synthetic resin product known as Vinylite.

The Commission's witnesses included Dr. John C. Hostetter, of the Hartford-Empire Co., of Hartford, Conn., a member of the American Society of Testing Materials, an organization devoted to the promulgation of definitions of, and specifications for, glass and other commercially marketed goods, in the interest of producers, consumers and the public generally; Dr. George W. Morey, a chemist of the Geophysical Laboratory of the Carnegie Institution of Washington and recognized nationally as an authority on glass; and Dr. Harrison E. Howe, for the past twenty years editor of a number of scientific magazines, one of which is sponsored by the American Chemical Society. Sam A. Brower, vice president of the Beau Brummell Ties, Inc., of Cincinnati, was the only witness representing the trades examined by the Commission at this Washington hearing.

Under examination by Eldon P. Schrup, the Commission's attorney, Dr. Hostetter put into the record the following definition of glass, promulgated by the American Society of Testing Materials: "Glass is an inorganic product of fusion which has cooled to a rigid condition without crystallizing. Some glasses contain non-glassy material, always imbedded in a glassy matrix. Glasses may be colored by suitable material in a dissolved or dispersed condition."

A motion by Walter H. Moses, attorney for Buchsbaum, to exclude the ASTM definition on the ground that the organization is not a recognized legal or governmental body, was overruled.

Asked if the ASTM definition would embrace the material from which Elasti-Glass products were made, the witness replied, "No."

Qualifying as an expert on glass, Dr. Hostetter said he was a member of the American Ceramics Society's committee on glass and a member of the International Commission on Glass Technology. He offered as further evidence a long list of published writings on glass, which supported the ASTM definition.

In cross-examination of the witnesses, Attorney Moses sought to show that Dr. Hostetter's citations were so old that they did not include the results of modern scientific developments of glass. He cited Webster's secondary definition of glass to be "a substance glass-like in appearance," and referred to the classification of glass products in the Patent Office as possibly qualifying Elasti-Glass as within the category of glass. Dr. Hostetter held to his view that a synthetic resin product had only one characteristic like glass in that it was transparent, and that Elasti-Glass did not contain any silicate substance and as a one component product was unlike glass.

Dr. Morey described his qualifications as an expert witness on glass by stating that he had been with the Geophysical Laboratory of the Carnegie Institution since 1912; was a member of the War Industries Board's committee on glass during the World War, and previously had been on the staff of the Bureau of Standards from 1909 to 1912, dealing with glass. He also has served as scientific consultant for a commerial glass company and had himself written, or collaborated on, sixteen articles on glass, most of which were published under the sponsorship of scientific societies. As author of the volume "Properties of Glass," Dr. Morey said he was responsible for the following definition of glass: "Glass is an inorganic substance in a condition which is continuous with, and analogous to, the liquid state of that substance, but which, as a result of having been cooled from a fused condition, has attained so high a degree of viscosity as to be for all practical purposes rigid."

In response to questions by the Commission attorney, Dr. Morey said he believed that it was most important that the term glass be restricted to those glasses which are commonly used in commerce and not take in any product made of a glass-like substance. He said that Elasti-Glass could not qualify as an "undercooled liquid," and was not embraced in his definition of glass. The cross-examination was of a highly technical and scientific nature, with Dr. Morey holding to his definition of glass as representing his view of what is glass.

Dr. Howe's examination was given a dramatic touch by the Government offering in evidence a pair of suspenders, described by the witness as made of Vinylite, and a tie, which the witness said was made of Fiberglas, with a cotton stitching, produced by the Owens-Corning Fiberglas Corporation. These two exhibits had been used by Dr. Howe in lectures which he gave in Chicago in February, 1940.

"The suspenders," the witness said, "are a very clever and unique use of Vinylite, a material made by the Carbide and Carbon Chemical Corporation, and I would not call them glass. To me glass is a very different material. The tie is made of Fiberglas, with cotton stitching, from the Owens-Corning Company, and it is a glass tie."

The Commission then introduced an advertisement of

(*Continued on page* 35)

INVENTIONS AND INVENTORS

A Summary of the Patents of Interest to the Glass Industry Issued During November

Compositions

A soda-lime glass composition referred to as a low alkali type for containers, which has chemical durability, combined with ease of melting and fining, was patented by Aaron K. Lyle of Hartford-Empire Co. (2,262,951). The preferred composition and the allowable range of the finished glass follow:

	Preferred Composition Per cent	Lower Limit Per cent	Upper Limit Per cent
Silica (SiO_2)	76.0	74.5	80.0
R_2O_3 (Principally Al_2O_3)	3.0	1.5	6.0
R O (Principally CaO)	6.9	2.0	10.0
Alkali (Principally Na_2O)	13.6	10.0	14.5
Fluorine	0.2	0.15	0.8

John H. Partridge of Pinner, England has worked out some limiting considerations for glasses consisting of silica, lime and alumina, designed to prevent the formation of anorthite ($SiO_2.CaO.Al_2O_3$) as a devitrification product (2,262,198, General Electric Co.). A necessary prerequisite is that the silica content be less than 65 per cent and that the theoretical maximum percentage of anorthite be less than about 56 per cent. The following table gives the composition ranges covered by the patent claims and the somewhat broader range disclosed as workable in the patent specification.

	Range Disclosed As Workable Per cent	Range Covered by Claims Per cent
Silica (SiO_2)	56-59	56-58
Lime (CaO)	14.6-15.5	15
Alumina (Al_2O_3)	15-20	19-20
Magnesia (MgO)	0-6	3-6
Zinc Oxide (ZnO)	1-9.5	1
Barium Oxide (BaO)	0-3	3
Phosphorous Pentoxide (P_2O_5)	0-1	—
Zirconia (ZrO_2)	0-1.4	—

Data of interest concerning these compositions are softening temperature 960-990° C, expansion coefficient 4.6 to 4.8 x 10^{-6}, and theoretical anorthite content 41 to 54.6 per cent.

Furnaces

Figure 1 shows one of the principal features of melting tank construction proposed by Joseph C. Keaney, Mt. Lebanon, Pa., in patent 2,263,848, to minimize metal-line wear and to make replacements easier. The flux blocks are recessed at the top so that a ring of overhanging refractory bustle blocks may rest on them and take the extreme wear at the surface of the molten glass. Obviously these bustle blocks need to be highly resistant to attack. They may sometimes be replaced without major repairs of the walls or hearth.

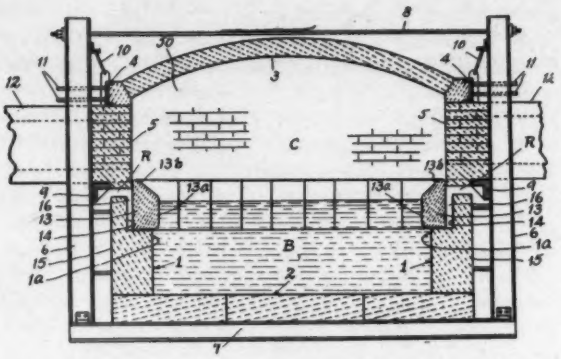


Fig. 1. 2,263,848: Keaney. Blocks 13a form a bustle to rest on top the recessed flux blocks so that the metal line wear will not require replacement of the entire wall.

The latest of many patents granted to Paul G. Willetts of Hartford-Empire Co. is 2,262,826 covering a monolithic bottom of refractory grain for glass melting furnaces. Insulation of the bottom to reduce heat loss is a primary consideration. Using refractory grain of the alumina-silica type he proposed the pouring or tamping of successive layers on the bottom plate, with no bottom blocks used. Preferably these layers vary in coarseness from the bottom to the top surface so as to give porous insulative layers at the bottom and dense glass-resistant surface layers. To finally prepare the top layer, a coating of glass-forming material (similar but possibly more refractory than the glass to be made in the furnace) is spread out and then fused into an impervious layer by a burning-in process. The latter heating step would be to a temperature higher than the normal operating temperature. The process is in many respects similar to the traditional method of "making bottom" in the basic open

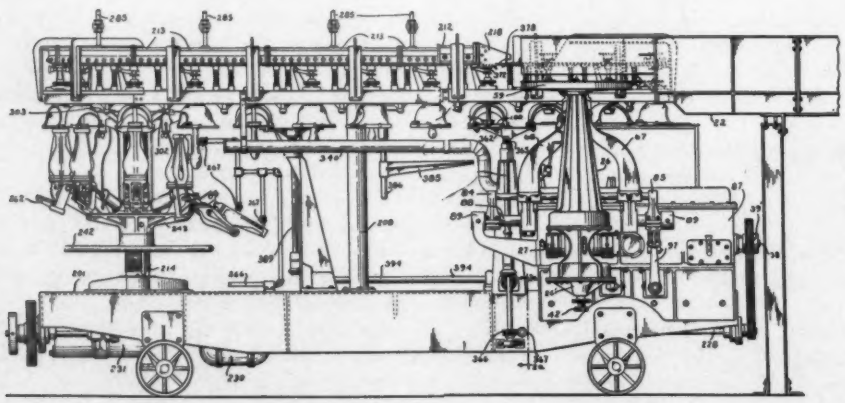


Fig. 2. 2,263,126: Gray, Pond and Weber. Corning's ribbon lamp bulb machine combined with a turret machine (at the left) for forming lamp bulbs, tumblers and lamp chimneys.

hearth steel furnace, where a monolithic grain bottom of dead burned magnesite is prepared. It might be mentioned that bottoms of this type develop holes or pits which can be repaired after each heat is tapped from the steel furnace. There would be no opportunity for daily repairs in a glass tank. However, the erosion factors are many times more severe in the open hearth furnace.

To prevent chilling of glass at the outer lip of the forehearth from which a suction gathering machine operates, George W. Batchell of Toledo places a metal tube in a recess of the outer wall of the bay at the glass surface level and directs a long flame through it (2,264,232).

For melting viterous enamels, Richard H. Turk of Baltimore (Porcelain Enamel & Mfg. Co.) has patented furnaces which pile up the batch in the end of a long smelting furnace and allow it to melt and flow away in a shallow stream to the quenching vessel (2,262,069 and 2,262,070).

Feeding, Forming and Shaping

Figure 2 shows a new Corning Glass Works high-speed forming machine which combines features of turret machines with the Corning ribbon machine which was developed initially for lamp bulbs. The range of ware which can be produced on this new machine includes lamp bulbs, tumblers, and lamp chimneys. In Figure 2 the right hand portion of the machine contains the ribbon forming elements while the final forming apparatus is the turret at the left. In connection with the forehearth 22 (upper right) a feeder separates gobs of glass from the bottom end of a stream, and a pair of cups (not shown) seizes and shapes the falling charges into parisons of a desired shape and then deposits them on the orifice plates 100 of a moving chain, in such a manner that the parts of the parison contacted by the shears are excluded from the articles later formed. On the continued advance of the loaded orifice plates blowheads associated with them function to blow the parisons into a form suitable for introduction into finishing molds. These molds are mounted on a turret and have a path of travel such that the partially formed articles suspended from the orifice plates enter the path of travel of the molds and are externally shaped thereby, then leave the path of travel of the molds and are subsequently separated from the cullet remaining and from the associated orifice plates.

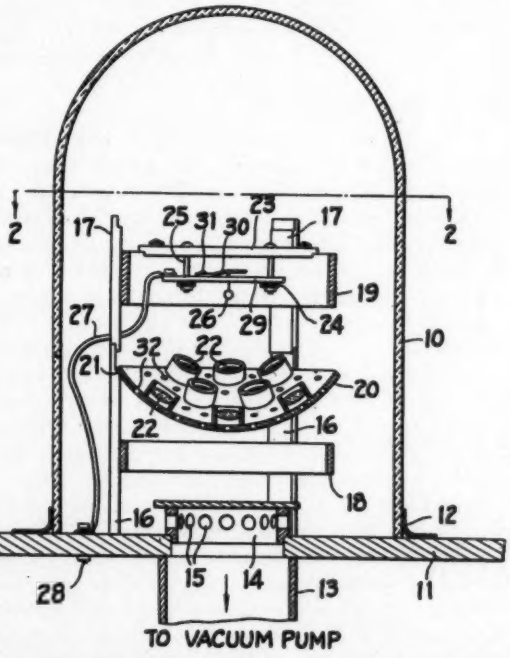


Fig. 3. 2,263,008: McRae. Apparatus which holds lenses in a vacuum chamber and contains a heating element 26 for volatilizing a metal fluoride onto the lenses to prevent Fresnel reflections.

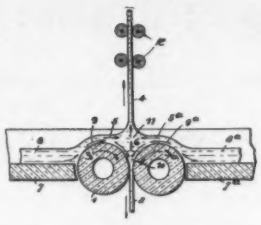


Fig. 4. 2,263,493: Habert. Thickness of the rising sheet is controlled largely by currents induced by drawing another sheet downward. The latter sheet is scrapped.

The patent covering this machine is 2,263,126 granted to David E. Gray and Leander N. Pond of Corning and Walter C. Weber of Painted Post, N. Y.

Mr. Gray received another patent 2,263,127 covering a new principle for making pressed glass articles. As contrasted with normal pressing operations whereby a gob is introduced into a mold followed by a shaping plunger, Gray proposes to use a molding apparatus which catches the dropping gob between a cup and plunger moving transversely across the line of fall and to immediately give it a final shaping. By such a method there should be no appreciable cooling of the skin surface before the article receives its final shaping.

George Ruppert of Sand Springs, Okla., has assigned to Alexander H. Kerr & Co. Inc. his patent 2,262,469 for a gob feeding apparatus which supports a glass reservoir on a piston so that the elevation of the piston raises the discharge orifice of the reservoir toward a plunger in line with the orifice, and causes glass to be discharged.

In making cellular glass Wm. O. Lytle, of New Kensington, Pa. (2,264,246 Pittsburgh Plate Glass Co.) introduces crushed glass into a column-like container filled with air or other gas under pressure, where it is fused to such an extent as will unite the glass particles and entrap air bubbles; the material is drawn through an orifice at the bottom into an atmosphere of reduced pressure which will expand the pores prior to annealing.

Patent 2,263,601 to Alfred Wendler of Berlin-Dahlem, Germany, describes a method for encasing metal wires or rods in glass tubing drawn tight over the metal. The metal is placed in a glass tube, a portion of the glass tube is heated to softness, and the metal is then drawn through the heated point, drawing the glass at the same speed so the metal will receive a thin tight fitting glass covering.

Plate and Sheet Glass

Figure 4 illustrates the means suggested by Louis Habert of Paris, France, for obtaining close control of a vertically drawn sheet, which consists in providing rollers at the base of the sheet to keep glass flowing toward the meniscus. The latter sheet is ordinarily to be considered as a waste product to be returned to the furnace as cullet. It is claimed that such an assembly allows a control of

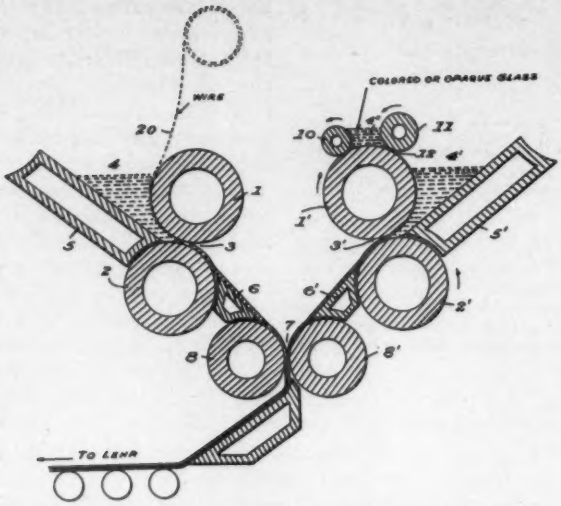


Fig. 5. 2,261,262: Lewis. Enforced glass made by feeding wire between two sheets of viscous glass receives a colored film of glass from a reservoir which rides on top the roll 1.

the glass currents to an extent which gives close control of the thickness of the vertically drawn sheets. This is patent 2,263,493 assigned to Anonyme des Manufactures des Glaces & Produits Chimiques de Saint-Gobain, Chauny & Cirey, Paris.

Patent 2,264,245 to Wm. O. Lytle, of New Kensington, Pa., has joined the Pittsburgh Plate Glass Co. group of patents on means of applying colored surfaces to glass sheet as it is drawn from a tank of clear glass. There are supply bodies of colored glass which feed by gravity onto the upper surface of a horizontally drawn sheet and by hydrostatic pressure onto the under surface, both occurring just before the sheet is passed through a pair of driven rolls which precede the lehr.

Mr. Lytle received also patent 2,264,244 for a blackboard made by coating a glass plate with an opaque enamel containing an abrasive substance such as silicon carbide.

Joseph H. Lewis of Kingsport, Tenn. in patent 2,261,262 (Blue Ridge Glass Corp.) describes a drawing process for making a wire reinforced sheet glass in which one of the two main component sheets which cover the wire, is coated with a film of colored glass. This is accomplished as shown in Fig. 5.

Wilbur F. Brown and John L. Drake of Toledo (Libbey-Owens-Ford Glass Co.) describe in patent 2,262,988 machines for cutting small glass tiles from a sheet of glass while it is in the hot plastic condition. The particular apparatus of Fig. 6 is strikingly similar to continuous cutters long used in other ceramic industries such as quarry tile and hollow structural tile. However, the Brown-Drake cutter cuts the sheet longitudinally as well as transversely.

Another Libbey-Owens-Ford patent is 2,263,005 granted to Donald L. McClure of Toledo for a supporting frame to hold sheets vertically while they are being bent. The sheet is supported at its lower edge by blocks on which it can slide laterally but which are equipped with wire-like elements which would prevent any large accidental movement. The sheet is held in a vertical position by a loose spring clamp at the top.

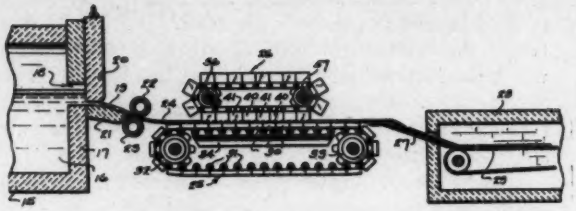


Fig. 6. 2,262,988: Brown and Drake. Cutter for forming titles from a continuous sheet.

Ferdinando Ferrè of Milan, Italy, in patent 2,263,679 has arranged a tempering furnace in such a way that the air blasting zone is under the heating zone, so that the sheets are lowered directly into it as soon as they have been adequately heated. The air blasts are directed at both sides of the sheet through many jets in oscillating nozzle plates. The blowers which provide the blast are set in operation by the movement of the sheet into the chilling chamber.

André Do Huu Chan of Sceaux, France (Société Anonyme des Mfg. de Glaces et Produits Chim. de Saint-Gobain) also has provided equipment useful in tempering glass sheets. It consists of the placement of a moving screen between the source of air blast or heat supply and the ware, to equalize the temperature treatment. The principle thus described in patent 2,262,545 is applicable to other heating and cooling processes.

A decorative tile is made by Arthur D. Nash of Sewickley, Pa. (Pittsburgh Plate Glass Co., 2,264,183) by spreading a powdered colored vitreous glaze over a glass plate, laying another plate on top and heating the assembly to cement the two plates together by fusing the glaze. James H. Sherts of Pittsburgh and Robert A. Miller of Tarentum, Pa. in another Pittsburgh Plate Glass patent (2,264,190) disclose a laminated non-glare polarizing unit which might be used in windshields.

Glass Wool and Fiber

Paul Ebaugh of Granville, Ohio, has assigned to Owens-Corning Fiberglas Co. his patent 2,261,148 for hydrofluoric acid treatment of fiber glass textiles to remove loose fiber ends. He reports that a three minute immersion in 20 per cent acid accomplishes this result and opens the weave noticeably, but without damaging the fibers within the yarns. The treated products are softer and more flexible. Other chemicals having similar effects, but not covered by the patent claims, were reported by Ebaugh as including potassium hydroxide and sodium hydroxide solutions and fluoride salts and pastes. In another Owens-Corning Fiberglas patent (2,263,217) Howard R. Lillie and Eric H. Loytty of Corning, N. Y., report that glass textiles made of low alkali fibers lose considerable strength in moist atmospheres but that this can be almost entirely prevented by a 5 to 30 minute prior heat treatment of the textiles at 50 to 340° C. In low alkali glasses (only) the heat treatment actually results in an increase in strength of the individual fibers. By low alkali glasses the inventors mean glasses with less than 3 per cent of the alkaline oxides. The heat treatment releases some of the strains set up in the weaving process.

(*Continued on page* 33)

CURRENT STATISTICAL POSITION OF GLASS

November activity in the glass industry was less than in the previous month but established a new record for this period of the year; employment held at the October level but payrolls dropped slightly. According to THE GLASS INDUSTRY's Production Index, output during November totalled $43,000,000 bringing the 11 months' total up to $426,000,000, as compared to $335,000,000 last year. These figures indicate that 1941 output will set a record of close to $470,000,000 which represents an increase of $100,000,000 over last year's estimated volume.

Plate glass production during November totalled 14,276,765 square feet, according to the Plate Glass Manufacturers of America. This was 10 per cent less than the previous month's total and was 12 per cent below the November, 1940, level. During the first 11 months of 1940, plate glass output amounted to 180,092,713 square feet as compared to 146,880,352 square feet in last year's comparable months—a decrease of 22 per cent.

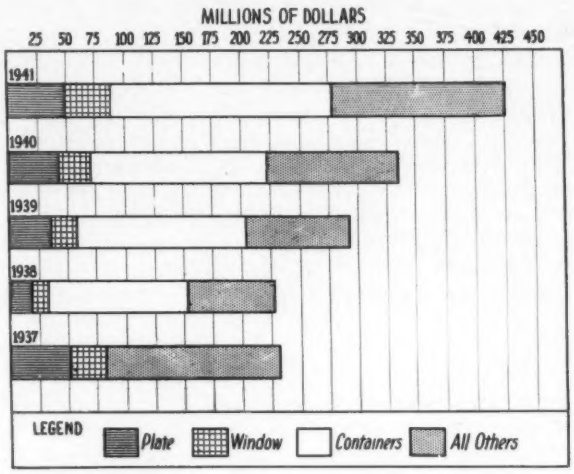
Window glass production during November totalled 1,299,913 boxes, which was 14 per cent below the previous month's level but about equalled 1940's corresponding month. Cumulative figures for the January-November period indicate an output of 14,857,000 boxes as a gain of 22 per cent over last year. During November the window glass industry operated at 80.1 per cent of capacity.

Glass container production during November totalled 6,178,615 gross, according to the Glass Container Association of America. This was 13 per cent less than the October total but exceeded November 1940 by 44 per cent. During the first 11 months of this year, production totalled 64,389,750 gross, as compared to 50,062,000 gross in last year's corresponding period. These figures indicate that productive activity in this branch of the glass industry has been 29 per cent greater than last year.

Shipments of glass containers during November declined 16 per cent from the prvious month's total to 5,281,197 gross; however, this was 30 per cent greater than the November 1940 total. Outstanding gains were reported over last year's corresponding month for beer bottles, which increased 173 per cent and pressure and non-pressure ware which expanded 153 per cent. Sales of general purpose ware were up 48 per cent, medicinal and toilet ware 42 per cent, narrow neck food containers 39 per cent, pressed food ware 34 per cent, milk bottles 23 per cent and wide mouth food containers 21 per cent. Sales of domestic jelly glasses and fruit jars were off 48 per cent and 18 per cent respectively and liquor bottle shipments dropped 9 per cent. Cumulative figures for the January-November period reveal that this year's shipments have exceeded 1940's volume by 31 per cent, having established the record total of 64,038,749 gross during these months. An analysis of the trends in individual lines indicates that all types or containers have made substantial gains—domestic fruit jars 95 per cent, beer bottles 53 per cent, pressure and non-pressure ware 44 per cent, domestic jelly glasses 39 per cent, general purpose ware 38 per cent, milk bottles 32 per cent, wide-mouth food containers 28 per cent, medicinal and toilet ware 25 per cent, narrow neck food containers 24 per

THE GLASS INDUSTRY'S INDEX

Production: Eleven Months, January Through November



CURRENT GLASS CONTAINER STATISTICS

(ALL FIGURES ARE IN GROSS)

Types of Ware	*Production*		*Shipments*		*End of Month Stocks*	
	Nov., 1941	*Nov., 1940*	*Nov., 1941*	*Nov., 1940*	*Nov., 1941*	*Nov., 1940*
Food Container (Narrow neck, wide mouth, and pressed)	1,543,598	1,068,387	1,261,527	1,007,342	2,183,297	2,166,677
Pressure and Non-Pressure	371,061	180,061	317,408	125,648	565,954	732,586
Beer	273,678	115,564	263,845	102,461	401,356	570,062
Liquor	1,189,604	1,118,551	1,039,969	1,138,423	1,818,302	1,551,914
Medicine and Toilet Prep.	2,045,495	1,299,510	1,758,008	1,230,074	2,655,519	2,964,283
General Purpose	403,205	334,572	379,763	256,860	428,606	664,124
Milk	257,002	191,050	242,693	196,898	344,223	328,815
Fruit and Jelly	77,812	27,305	3,321	4,133	273,126	418,428
All Other	17,160	15,688	14,663	14,382	40,161	35,301
Total Industry	6,178,615	4,350,688	5,281,197	4,076,721	8,710,544	9,432,190

cent, liquor ware 22 per cent and pressed food ware 20 per cent.

Inventories of glass containers were 8 per cent lower at the close of November than they were on last year's corresponding date. Stocks of all types of ware declined with the exception of milk and beer bottles and food containers which increased.

Miscellaneous glass products manufactured during November were valued at $17,000,000 compared with $14,000,000 in November 1940.

Machine-made tumbler production during November amounted to 4,633,694 dozens, which was 52 per cent greater than in 1940's corresponding month. During the first 11 months of this year, tumbler output totalled 48,635,604 dozens—20 per cent above last year's level. Shipments during November increased 28 per cent over November 1940 to 3,584,296 dozens, bringing the January-November total to 22 per cent above 1940's comparable period to 48,101,168 dozens. Finished stocks of tumblers dropped 3 per cent below the November 1940 level to 7,902,681 dozens.

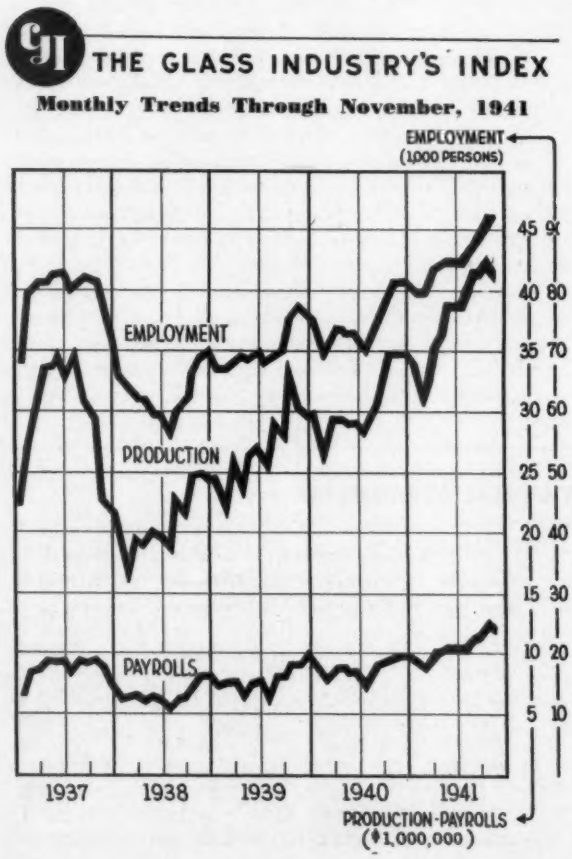
Manufacturers' sales of machine-made table, kitchen and household glassware totalled 3,279,174 dozens or 11 per cent more than a year ago. For the 12 month period ending November 30, 1941, this trade amounted to 38,988,484 dozens—15 per cent more than the previous 12 months' total of 33,800,099 dozens.

Employment and Payrolls: Employment in the glass industry during November held close to the 93,000 record set in October. This compares with 81,500 in November 1940.

Payrolls in the glass industry during November dropped $500,000 below the October figure to $12,500,000. During the first 11 months of 1941 glass manufacturers paid out close to $122,000,000 in wages; last year's comparable total was $94,000,000.

Foreign Trade: The Department of Commerce has ceased the publication of foreign trade statistics for the duration of the war so that this information cannot be used by the enemy. This is the same policy that other belligerent countries have followed in order to maintain secrecy relative to vital statistics. Therefore, it will be necessary for THE GLASS INDUSTRY to suspend the publication of Foreign Trade data.

For the benefit of our readers, however, we report the significant statement published last month, that during the first 9 months of this year, exports of glass and glass products totalled $15,018,000 as compared with $9,987,000 in 1940's comparable months and $6,000,000 in 1937. Imports dropped from $1,963,000 in 1940's January-September period to $1,023,000 in 1941; this was less than 1/7 of 1937's corresponding trade.



APPLIED OPTICAL INDUSTRIES, INC.

The land and building of the Optical Glass Products, Inc., Hamburg, New York, have been purchased by a corporation operating as Applied Optical Industries which have been founded to carry on the project for the molding and precision annealing of optical raw glass for ordnance optics requirements. This company will handle the processing of optical raw glasses made by all manufacturers including Chance Bros., Bausch & Lomb, Corning and Pittsburgh Plate. At the present time the facilities of the plant are being expanded to take care of a large part of the independent needs for optical moldings by the Government as well as by manufacturers of ordnance instruments.

The company will operate under the guidance of Alex J. Weinstein who, for a number of years, has been the agent in this country for Chance Bros. & Co. Ltd. The offices of the company will be located in New York City at 95 Madison Avenue. The factory operations will be in charge of Mr. Harry Rumel.

"VICTORY MARKET PLACE"

A "Victory Market Place" to bring together owners of idle equipment and manufacturers holding war contracts has just been launched by the N. Y. Journal of Commerce. This clearing house for idle tools and machinery that can be used by contractors and sub-contractors on Government orders is being prepared in cooperation with the Contract Division of O.P.M.

In conjunction with the "Victory Market Place," The Journal of Commerce now presents each Tuesday a page of case histories explaining how individual manufacturers are actually meeting production, equipment, packaging and transportation problems arising out of the war. Manufacturers in all branches of industry are cooperating in this effort to publicize ideas that work for general use.

The first three editions of this new "War Industries" service have been published in reprint form. Reprints may be had at 10 cents each from the N. Y. Journal of Commerce, 63 Park Row, New York.

Research Digest

Practical Interpretations of Glass Technology

THE GLASS INDUSTRY inaugurates with this issue a department devoted to the discussion of published researches on glass from the point of view of their industrial applications.

In the long view of history, the industrial arts preceded the sciences. Thus, adequate glass apparatus was ready for the chemist before chemistry worthy of the name was born. Processes and methods, compositions and techniques were developed long before science pointed out the reasons why or gave any indications of leadership.

This state of affairs has become reversed, so far as the glass industry is concerned, during the past generation. Technology has overtaken rule-of-thumb in the manufacturing establishments that are out in front in the march of progress and those which employ groups of engineers, physicists and chemists, and which take advantage of the published findings of research laboratories. Very often, the subjects investigated and the data reported seem to have no direct bearing upon the development of new products or upon the improvement of existing processes.

It will be the purpose of this department to attempt the evaluation of research papers in terms of their direct application to the business of manufacturing glassware and the utilization of product. Many researches and discoveries, however interesting they may be from the scientific point of view, are completely useless and academic as seen by the manufacturer. Some of these will remain in that category; others will become vitally important as new needs arise or as industrial techniques catch up with scientific discoveries. The first group of papers selected for comment appeared in 1940.

Durability

The work of F. R. Bacon and O. G. Burch (*Jour. Amer. Ceram Soc.*, Jan. 1940) showed that accelerated tests do not agree with actual service tests. That is, if a bottle glass is crushed, and the powdered glass is treated with hot distilled water, the comparative rating of this glass against another similarly treated may not be the same as the comparative behavior of the same glasses in actual bottles, filled with solution and stored for long periods. In particular, testing with distilled water does not tell the story of resistance against acid, nor does a rapid test with dilute acid establish the resistivity of the glass toward alkaline solutions.

This seems to mean that the manufacturer ought to test his bottles or bottle glasses by using the actual liquids that will be stored in the bottles, or by solutions representing such liquids in acidity or alkalinity.

Surface Tension

While variations in surface tension must be reflected in certain forming processes and in the fining or plaining of glasses, this property is so overshadowed by viscosity as an influence that any attempt to control surface tension by altering compositions seems generally futile.

Accordingly, such papers as that of Babcock, on the dipping-cylinder method (*Jour. Amer. Ceram. Soc.*, Jan. 1940), demonstrating the slight change of surface tension with temperature, rating certain oxides as to their effect (Al_2O_3) MgO) CaO) SiO_2), and confirming the findings of previous investigators, must be regarded as without immediate technical value.

Analysis

In view of the excellent work done by G. E. F. Lundell, National Bureau of Standards, and by collaborating laboratories, the glass analyst of today would do well to discard the older textbook methods in favor of short, but nevertheless well-tried and sufficiently accurate new methods specifically adapted to the analysis of commercial glasses.

Webster and Lyle (*Jour. Amer. Ceram. Soc.*, Aug. 1940) have presented a scheme embodying methods so rapid that a glass may be completely analyzed in one working day. This contribution may well be regarded as a guide for the routine analyst in the glass plant laboratory.

Diffusion of Helium Through Glass

At first glance, this subject seems to belong in the "what-of-it?" class. Not many bottles or flasks will be made for the storage of helium.

But, as a further approach to the understanding of the "fine structure" of glasses, such a paper as that by Smith and Taylor (*Jour. Amer. Ceram. Soc.*, May 1940) is a useful contribution. X-ray work has indicated that the atoms in a silica glass must be tied together in such a fashion that the stuff is full of holes through which tiny atoms of the helium size might well creep. When bases are added to the silica, they must find placement for their metallic atoms in these holes, plugging them more or less against the passage of helium.

At the moment, such facts or ideas cannot work any change in manufacturing processes. But, in the longer view, any discovery that contributes to more knowledge of the liquid state—to which glasses belong—must be welcomed and preserved, against the day when some new application of glass requires some understanding of its very insides.

Electrical Conductivity

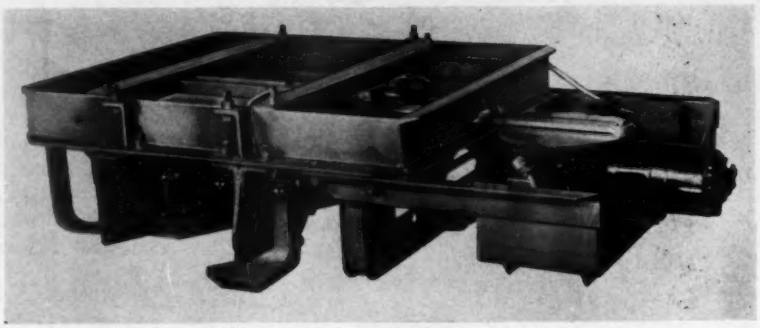
To most of us, glass is a non-conductor of electricity, and that is why we see more glass insulators than people. But it is well to remember that insulation is only relative, not absolute. Glass becomes a good enough condutor, when it is hot, to permit the operation of electric glass furnaces in which the current is carried through the glass itself. A quantitative contribution is made by Badger and White (*Jour. Amer. Ceram. Soc.*, Sept. 1940), who show that the potash-lead glasses are much better resistors than the soda-lime glasses. Makers of incandescent lamps and radio tubes already know this fact, but the specific information may become useful in other applications of glass as an electrical insulator.

NEW EQUIPMENT AND SUPPLIES

MOTOR-DRIVEN SWITCH

A new electrically operated track switch known as a Motor-driven Type H Switch has been developed by the Cleveland Tramrail Division of The Cleveland Crane & Engineering Co., Wickliffe, Ohio, for use on cab-operated, gravity, or automatic dispatch overhead materials handling systems. This development enables the Tramrail operator to pre-set the switch at some distance ahead while traveling and thus save time lost when switching by hand. Likewise, indexes on gravity or automatic dispatch carriers may be set to actuate trippers which will cause one or several switches to take the positions desired.

The switch is ruggedly built of steel welded and consists of two main assemblies—an outer supporting frame and an inner sliding frame. The outer frame is designed for bolting rigidly to the super-structure. The inner assembly carrying a straight and curved rail, rides on multiple easy-operating rollers, and is set in position by a motor-driven cam through a lever arrangement.



Cleveland Tramrail's Motor-driven Type H Switch.

"CLIPPER" TRUCKTRACTOR

The Clark Tructractor Division of Clark Equipment Co., Battle Creek, Mich., has developed a sturdy, low-priced, compact, fork type truck that is said to incorporate all desirable features in modern truck design. Christened the "Clipper," these trucks are offered in six models, capacities 1000, 1500, 2000 lbs. with standard finger lifting heights of 60 to 108 inches, other special heights optional.

Gas-powered for 24-hour continuous service, the Clipper has an economical four cylinder industrial truck engine, front wheel drive, rear wheel steer, hydraulic lift and tilt. Self starter and hydraulic brakes are standard equipment. The driver rides on a comfortable spring suspended seat with all controls within easy reach, thus permitting safe operation at speeds from one to seven miles per hour forward or reverse.

AIR PUMP CATALOG

A new loose-leaf edition of the Gast Rotary Air Pump and Compressor Catalog has just been issued by Gast Mfg. Corporation. The new catalog contains data on the company's line designed to meet especially the needs of Defense production—including the new Gast V-Belt Driven Air Pump.

In addition to illustrations and detailed descriptions of the various models, the catalog presents specifications, engineering data and performance tables for 10 sizes of Gast Rotary Air Pumps, ½ to 23 C.F.M., vacuum to 28 in. and pressures up to 30 pounds. Also a section of photographs and descriptions of Gast applications in industry and as standard equipment on many types of machines.

ANALYZING MEDIUM GOGGLE

The Polarizing Instrument Company, New York, has improved the design and construction of goggles used as an analyzing medium on glass strain testing polariscopes. The new analyzing goggle is mounted in a complete metal frame which not only totally eliminates smearing and slipping, but also reduces the chance of breakage if the goggles drop. They are designed so that the wearer can have his own correction lenses mounted within the analyzing goggles.

The old type goggle had several objections, it was a lamination of quartz on Polaroid cemented by Canada Balsam. In a warm room the quartz would not only smear but would also slip from its correct axis of orientation. If the goggles were dropped, it meant almost certain breakage of a very expensive item. For the individual who normally wore correction spectacles, the old style made it necessary to wear the analyzing goggles over the correction spectacles, making a very awkward working medium.

BOOTHCOTE

The Harris Soap Company of Buffalo, New York, has developed a spray booth coating, Boothcote, that is said to cut spray booth cleaning to a few minutes instead of the usual hours necessary for this job. The process is a simple one. Boothcote is sprayed on the clean metal walls of the spray booth; waste paint, lacquer, or enamel, is allowed to accumulate, and then the whole mass of waste paint is removed in a large sheet, or in as large a sheet as a man can handle. Another rapid coating of the metal walls and the booth is ready to be used again in production. No scraping is necessary in removing the paint since the accumulation practically falls off due to its own weight once it is loosened from the metal walls where it lays tightly until the spray booth operator is ready to sheet it off the walls.

The old way of handling the spray booth cleaning problem was to line the booth with kraft paper or cardboard and then remove the lining when it became too heavily loaded with waste paint. Besides the disadvantage of the man-hours of labor involved there was always the cost of spoiled finishes due to the weighted-down cardboard falling on work being sprayed.

Boothcote, the company claims, is non-toxic, non-imflammable, and will not harm the skin. It is used by the War and Navy Departments.

CATALOGS RECEIVED

Light Conditioning Company of America, New York City. A folder on "Artfiber," an all glass product consisting of fiber layer interlayer of varied pattern and color hermetically sealed between two sheets of glass, describing the architectural and artificial lighting uses.

General Electric Company, Schenectady, N. Y. Two new bulletins. GEA-3660 explains in detail the design, construction, and application of the new 2300-volt contactor motor starter which can be safely applied to high-capacity power circuits.

GEA-3680 — The Recording Photoelectric Spectrophotometer for the graphic measurement of color.

The Brown Instrument Company, Philadelphia, Pa. Catalog No. 8301—"Industrial Control Devices—Products of Minneapolis-Honeywell Regulator Company." A 56 page catalog illustrating forty-four industrial controls and safeguards.

CATALOG & BULLETIN SERVICE

Current catalogs and manufacturers' service bulletins reviewed in this department may be obtained by writing to THE GLASS INDUSTRY.

INVENTIONS AND INVENTORS

(*Continued from page* 28)

Patent 2,262,094 to Henry J. Burt of Wheaton, Ill., covers a machine for applying dry nodules of insulating fiber wool by blowing.

Miscellaneous Processes

To improve the chemical durability of glass ware Aaron K. Lyle and Donald E. Sharp of Hartford-Empire Co. suggest the use of three groups of materials as follows:

Patent No.	*Material*
2,261,689	Halogen-substituted saturated hydrocarbons (bromoform, acetylene-tetra-bromide, carbon-tetra-chloride, monochlor-benzene).
2,261,690	Single ring type aromatic hydrocarbons (benzene, zylene).
2,261,691	Acetone.

The method of using each of these groups of liquids is to introduce about 0.2 cc per pint of contents of the container while the container is above 300° C. This may be done before or during annealing or tempering.

Figure 3 illustrates the holder designed by Daniel B. McRae of Rochester, N. Y. (2,263,008, Eastman Kodak Co.) for lenses to be treated by volatilized metal fluorides to reduce reflections. A similar apparatus was described in John H. McLeod's patent 2,260,471 (Dec. 1941 GLASS INDUSTRY). An air tight bell jar connected to a vacuum pump houses a lens support and the filament 26 which is the source of the fluoride.

Although Prince Rupert's drops, the earliest form of tempered glass, were quenched in water, this is such a severe chilling medium that attempts to use it in tempering shaped commercial articles have always resulted in the destruction of the articles. Molten baths which have been successfully used include oils, molten metals and salts, and synthetic materials such as light chlorinated resins. Ralph K. Day of Snyder, N. Y., reports in patent 2,263,489 (Corning Glass Works) his discovery that although water cannot be used alone, a small addition of water to molten salts such as the nitrates, nitrites, chlorides and sulphates of barium, calcium, sodium, and potassium, yields tempering baths which have markedly superior chilling ability to the molten salts alone. The usable range is about 105 to 550° C. The chilling power of such baths does not increase directly with the water content, but is said to reach a maximum at about 15 per cent water.

Lamp bulb manufacture is the subject of patents 2,262,760 to Roland M. Gardner of Swampscott and Ralph L. Allen of Beverly, Mass., (Hygrade Sylvania Corp.), 2,263,093 to Philip J. Kayatt of New York City (assigned to Harry C. Zaun, Atlantic Beach, N. Y.), 2,263,171 to Robert F. Hays, Jr. of Bloomfield and Alva L. Herman of Montclair, N. J. (Westinghouse Elec. & Mfg. Co.) and 2,262,176 to Walter J. Geiger and Wilson Davidson of Cleveland (General Electric Co.). The last three are concerned with fluorescent lamps or other gaseous discharge lamps.

William Bierman of New York City received patent 2,261,214 for a glass cutter for opening filled ampoules or for cutting any other type of glass tubing.

Woldemar Weyl of the Dept. of Ceramics at Pennsylvania State College has developed in patent 2,261,197 assigned to American Optical Co., a polishing material to take the place of rouge. His method is to heat clay to some temperature between 500° C and 900° C, which will activate the alumina and not be high enough to cause vitrification. A soluble salt of iron or another metal may be added to the clay before heating it so as to provide another metal oxide in the finished product. The chemical tests applied by Dr. Weyl to make certain that the alumina is sufficiently activated will be interesting to many.

The decorating machine described in patent 2,261,255 issued to Albert S. Jackson of Wood River, Ill. (Owens-Illinois) does the neat trick of applying screen decorations simultaneously to the neck and body portions of a bottle which is being rotated; since these portions have different diameters their peripheral speeds are of course different. Jackson considers his invention a further development of the apparatus in patent 2,231,531 granted Feb. 1941 to Albert Jackson and Clarence A. Heyne.

ENGINEER WANTED. Combustion engineer, preferably with glass house experience. Should be capable of handling plant maintenance and tank problems. Fine opportunity for the right man. Age not important. Reply to Box 45, The Glass Industry, 11 W. 42nd St., New York City.

YOUNG COLLEGE GRADUATE WANTED. Apprentice engineer wanted for service in glass plant. Experience not necessary. Present plant engineers are aware of this advertisement. Excellent opportunity for the right man. Reply to Box 46, The Glass Industry, 11 West 42nd St., New York City.

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Engineers and Contractors

for

The Glass Industries

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119 Federal Street, Pittsburgh, Pa.

Phone FA 1445 **Cable "Forter"**

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

Base Materials

		Carlots	Less Carlots
Barium carbonate ($BaCO_3$), Crude, (Witherite)			
90%, 99% through 200 mesh	ton	....	....
Precipitated material		55.00	60.00
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00–16.00	18.00
Borax ($Na_2B_4O_7 10H_2O$)	lb.	....	....
Granulated	In bags, lb.	.0225	.028 –.0305
Powdered	In bags, lb.	.025	.0305–.033
Boric acid (H_3BO_3) granulated	In bags, lb.	.0495	.0555–.058
Calcium phosphate ($Ca_3(PO_4)_2$)	lb.	.07	.07½
Cryolite ($Na_3Al\ F_6$) Natural Greenland (Kryolith)	lb.	.950–.975	.10
Synthetic (Artificial)	lb.	No supplies available.	
Feldspar—(published list prices)			
20 mesh	ton	11.00–13.25	
40 mesh	ton	11.50–13.75	
Granular	ton	11.75–14.00	
Semi-granular	ton	11.00–13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags.			
Fluorspar (CaF_2) domestic, ground, 96–98% (max. SiO_2, 2½%)			
Bulk, carloads, f. o. b. mines	ton	33.00–34.00	....
In bags	ton	35.40–36.40	47.00–50.00
Kryolith (see Cryolite)			
Lead Oxide (Pb_3O_4) (red lead) (N. Y.)	lb.	.0835	....
In 5 Ton lots	lb.	....	.0875
Less than 5 Tons	lb.	....	.0925
Lime—			
Hydrated ($Ca(OH)_2$–MgO) (in paper sacks)	ton	10.50	8.50
Burnt (CaO–MgO) ground, in bulk	ton	7.50	....
Burnt, ground, in paper sacks	ton	9.50	9.50
Burnt, ground, in 280 lb. drums	Per drum	2.35	2.35
Kiln Dried ($CaCO_3$–$MgCO_3$) 10x30 mesh	ton	2.00	....
Kiln Dried ($CaCO_3$–$MgCO_3$) 16x20 mesh	ton	2.00	....
Nepheline Syenite, f. o. b. shipping point	ton	12.50	16.00
Potassium carbonate—			
Calcined (K_2CO_3) 96–98%	lb.	.065	.0675
Hydrated 80–85%	lb.	.055	.0575
Salt cake, glassmakers (Na_2SO_4) in bags	ton	21.00–22.00	28.00–30.00
in bulk		17.50	
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat Per 100 lb.	.95	....
In barrels	Per 100 lb.	1.35	....
In Paper bags	Per 100 lb.	1.10	....
In Burlap bags	Per 100 lb.	1.15	....
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	Per 100 lb.	....	3.00–3.40
95% and 97%			
Bulk	Per 100 lb.	1.35	....
200 lb. bags		1.4675	1.48
100 lb. bags		1.475	1.50

Special Materials

		Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)	lb.	.031–.034	.045
Aluminum oxide (Al_2O_3)	lb.	.07	.09
Antimony oxide (Sb_2O_3)	lb.	.15	.15½–16½
Arsenic trioxide (As_2O_3) (dense white) 99%	....	....	.10–.12
Barium nitrate ($Ba(NO_3)_2$)	lb.	....	Open price.
Pyrophyllite, (20% Al_2O_3)	ton	10.00	13.00
Sodium fluosilicate (Na_2SiF_6)	lb.	....	....
Tin Oxide (SnO_2) in bbls.	lb.	....	Open price
Titanium Oxide (ceramic grade) (Priority)			
In bags	lb.	.15½	.15¾–.16¼
In barrels	lb.	.15	.16 –.16¼
Zinc Oxide (ZnO)			
American process, bags	lb.	.07¼	.07½
White Seal, 150 lb. bbls.	lb.	.09	.09¼
Green Seal bags	lb.	.08¼	.08½
Domestic White Seal bags	lb.	.08¾	.09
Red Seal, bags	lb.	.07¾	.08
Zircon			
Refined Granular (Milled .01–.02c. higher)		.06½	.07–.08

Coloring Materials

		Carlots	Less Carlots
Barium selenite ($BaSeO_3$)	lb.	....	1.40–1.60
(Commercial, 25% Selenium)	lb.	....	.85
Cadmium sulphide (CdS)	lb.	....	1.10–1.15
Cerium hydrate—			
100 lb. drums and 600 lb. barrels	lb.	....	.60
Chrome Oxide Green, 400 lb. bbls.	lb.	....	.25–.28
Chromite (99% through 200 mesh)	ton	55.00	58.50
Chromite ore (air floated)	ton	55.00	58.50–73.00
Cobalt oxide (Co_2O_3)			
In bbls. 350 lbs. or more,	lb.	....	1.84
Less than 350 lbs.,	lb.	....	1.94
Copper oxide—			
Red (Cu_2O)	lb.	....	.20–.22
Black (CuO)	lb.	....	.19–.22½
Black prepared	lb.	....	Open price
Iron Oxide—			
Red (Fe_2O_3)	lb.	....	.06–.10
Black (Fe_3O_4)	lb.	.04½	.09
Iron Chromate	lb.	....	.035–.05
Lead Chromate($PbCrO_4$) in bbls.	lb.	....	.16
Lithium Carbonate	lb.	....	1.25
Manganese, Black Oxide (Caucasian)			
In Paper bags	ton	70.00	78.00
In Burlap bags	ton	71.75	79.75
In Casks	ton	74.00	82.00
Neodymium oxalate, 50 lb. drums	lb.	....	4.00
Nickel oxide (Ni_2O_3), black	lb.	....	35–.40
Nickel monoxide (NiO), green	lb.	....	.35–.37
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals and Granular	lb.	.09¼	.09¾–.10
Powdered	lb.	....	.10¼–.10½
Potassium Chromate (K_2CrO_4) 100 lb. kegs	lb.	....	.27
Powder blue	lb.	....	.21–.25
Rare earth hydrate—			
100 lb. drums	lb.	....	.35
325 lb. barrels	lb.	....	.30
Selenium (Se) In 100 lb. lots	lb.	....	1.75
In lesser quantities	lb.	....	1.85
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.07¼	.07½–.07¾
Sodium chromate (Na_2CrO_7) Anhydrous	lb.	.08⅛	.08⅞–.09⅛
Sodium selenite (Na_2SeO_3)	lb.	....	1.50–1.65
Sodium uranate (Na_2UO_4) Orange	lb.	....	1.65
Yellow	lb.	....	1.65
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.40	3.75–4.15
Flowers, in bags	Per 100 lb.	3.05	3.40–3.80
Flour, heavy, in 250 lb. bags	Per 100 lb.	2.95	3.30–3.70
Uranium oxide (UO_2) (black, 96% U_2O_6) 100 lb. lots. Black	lb.	....	2.55
Yellow orange	lb.	....	1.65

Polishing Materials

		Carlots	Less Carlots
Emery, Turkish	lb.	.075	.08
Pumice Stone,			
American Ground FFF, FF, F	lb.	....	....
0, 0½, ½, 1	lb.	....	....
Putty Powder	lb.	Open price.	
Rotten Stone, (Domestic)	lb.	.02¼	.03½
Rouge, Red	lb.	.18	.16
Black	lb.	.15	.18

THE FTC-ELASTI-GLASS HEARINGS

(*Continued from page* 25)

the Buchsbaum Company, showing a picture of Dr. Howe with the men's accessories, and a reprint of a news article which the Government claimed carried the inference that Dr. Howe was endorsing the respondent's product. The witness said the advertisement did not reflect his views. Asked if the company had obtained his consent to the use of the advertisement, Dr. Howe replied in the negative. On cross-examination, Dr. Howe was asked if he had written to the company and objected to the advertisement, and the witness replied, "No, for obvious reasons," but made no further statement. In general, Dr. Howe supported the definitions of glass attributed to Dr. Hostetter and Dr. Morey. He held that a synthetic resin material could not, in his view, qualify as a glass.

Witness Brower testified to what he described as confusion in the minds of the trade as to accessories made from real glass and those made from synthetic resin materials.

The Buchsbaum Company has filed a general denial to the charges made by the Commission that its product, including belts, garters, suspenders and wrist-watch bands, advertised as "Elasti-Glass" had violated the Trade Commission Act. Among the contentions made in the answer was that "Elasti-Glass material is a form of glass because it is a synthetic resin glass scientifically produced and emphasizes its elasticity, which clearly distinguishes it from inorganic glass products."

A CORRECTION

Editor, THE GLASS INDUSTRY:

Unfortunately, due to a copying error in our office, the units given in my communication to you on volatilization of soda in a soda lime glass tank were incorrect. They should have read 0.3 *pounds* Na_2O per sq. ft. per day at 1425° C. instead of .3 per cent Na_2O.

General Electric Company
R. W. Newman, Engr.
Pitney Glass Works No. 54

OLEAN GLASS CO. EXECUTIVES MOVED TO ELMIRA, N. Y.

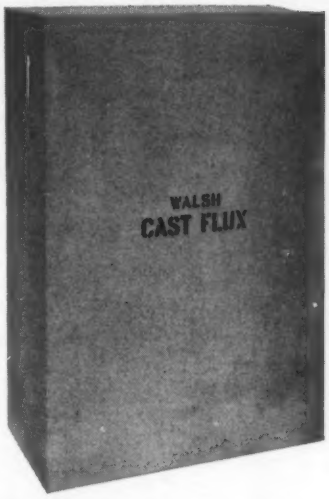
Effective Jan. 1, 1942, the executive and general sales offices of the Olean Glass Co., Inc., of Olean, N. Y., will be moved to Elmira, N. Y., and combined with those of the Thatcher Manufacturing Co., manufacturers of milk bottles.

Since 1935 the Olean company has been a wholly owned subsidiary of Thatcher Manufacturing Company but has operated as a separate company, out of Olean, N. Y.

Walkerman D. Dugan, now president of the Olean Glass Co., will in addition become a vice-president of Thatcher, with headquarters in Elmira.

Franklin B. Pollock, formerly sales manager of Olean, will become vice-president of that company, with head-

WALSH CAST-FLUX



The Vacuum-cast flux block of superior quality.

Walsh Cast-Flux blocks are machine-trued to exact size and shape after burning.

THEY LAST LONGER

The excellent results obtained in numerous tanks melting various types of glass has definitely established the efficiency and economy of Walsh Cast-Flux blocks.

Walsh Cast-Flux has a dense, uniform structure; it is burned at higher temperatures, is thoroughly bonded and possesses a low coefficient of expansion.

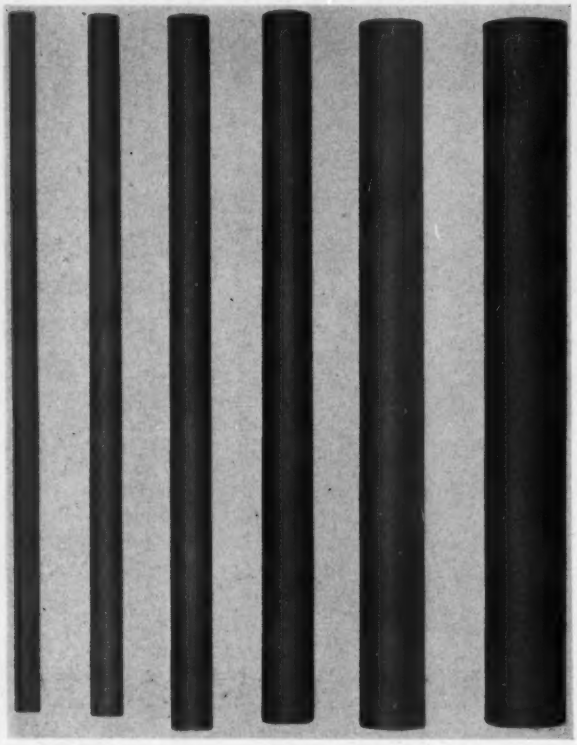
Walsh Cast-Flux blocks meet the most rigid requirements for tanks operating at higher temperatures . . . they insure greater tonnage, higher quality glass, freedom from defects, longer life and maximum economy.

WALSH REFRACTORIES CORPORATION

Manufacturers of Refractories for the glass industry for over 50 years

4428 North First Street
St. Louis Missouri

Malleable Iron Rods for plugging Moulds



1/8" 3/16" 1/4" 3/8" 5/8" 1/2" x 6"

IN the manufacture of Malleable Rods a "white iron" is produced Fe3C. The carbon is present in the combined form. The "white iron" castings are annealed or graphitized so that the final structure consists of ferrite (Fe) and free carbon (C) which is in the form of "temper" carbon.

This material is very soft and will pein readily.

Machinability

It is generally known, in commercial operations, Malleable iron machines more readily than other ferrous materials of equal tensile properties.

May we send you a descriptive booklet or answer questions on your specific problems?

GUNITE FOUNDRIES CORPORATION

ROCKFORD ILLINOIS

Established 1854

quarters in New York City. He will be in charge of general line sales in the metropolitan area.

George Dusterdieck, formerly in charge of the Buffalo office, has been appointed sales manager of the Olean Glass Company and will make his headquarters in Elmira.

The Olean company will continue to manufacture a general line of glass containers, operating as a division of Thatcher Manufacturing Company. Branch sales offices will be maintained in various metropolitan centers as heretofore.

This action is being taken to better utilize the personnel of the two companies and to make available to Olean's customers the service and research facilities and the modern manufacturing technique of the Thatcher Manufacturing Co.

Your Strength, for the Power of America

Ordinarily, an editorial directing attention to an advertisement would be considered not only an imposition on the reader but a piece of favoritism unfair to other advertisers. But this case is different. We ask you to read *every word* of the one-page advertisement which we have gladly given to the Treasury Department of the United States, on page 38 in this issue.

It is an outline of the benefits of the Defense Savings Pay-Roll Allotment Plan, a voluntary system whereby every business house and its employees can put their strength into the effort which America is making.

This plan is one which should have a tremendous appeal. It will provide a continuous and mighty torrent of funds to power our war industries and our fighting forces. It will enable all workers to take part in the defense of America and the achievement of Victory and Peace. It will give employees an anchor to windward in the post-war period of readjustment. It will help to curb inflation by putting present excess purchasing power into a great reservoir of future purchasing power which can be drawn upon when the stimulation of present emergency spending is past. Thus it will help to build a back-log against the effects of a future depression.

Finally, this is distinctly a plan of saving *for the people,* and a more fair and *American* way to finance the Nation's effort than by high-pressure drives and compulsory programs on the Nazi model. Let's make it clear once and for all that the latter method will not be necessary if Americans realize their responsibilities, as we believe they now do.

This organization has adopted the Defense Savings Plan. We hope that you and all our readers will do likewise. It's the least we can do to help this Nation win through for victory and justice in our times.

FLUXTITE by LACLEDE-CHRISTY

. . . the tank block of accurate structure balance made by ceramic experts from a precision blend of fire clays, including the famous Missouri Washed Pot Clays.

Fluxtite and its companion products, Laclede's Super Refractory Mix 89 and Laclede's Refractory Upperstructure, have been and are now meeting the strict requirements of the producers of soda-lime, boro-silicate and all other glasses.

Laclede-Christy, "The Glass Industry Specialists," have everything in refractories for the glasshouse. Consult with . . .

LACLEDE-CHRISTY

The World's Largest Producers of Glass House Refractories

ST. LOUIS . . TOLEDO

COLORS that *Sell!*

● Colors from HOMMEL give extra attractiveness to your products—lend an unusual richness that SELLS. Hundreds of satisfied customers use eye appealing HOMMEL shades for finest results.

Transparent and Opaque — Enamels and Fluxes — Liquid Lustre Colors — Acid and Alkali Resistant — Ices — Squeegee Colors — Burnish Gold and Silver.

Complete line of Glassmakers Chemicals including Barium Carbonate — Borax—Cadmium Sulphide—Feldspar — Fluorspar — Manganese Dioxide — Potassum Bichromate — Soda Ash — Sodium Nitrate — Uranium Oxide.

THE O. HOMMEL COMPANY

209 FOURTH AVE., PITTSBURGH, PENNA.

Factory: CARNEGIE, PENNA., New York Office: 200 WEST 34th ST.

For All Types of Glassware Moulds & Grey Iron Castings

OVERMYER MOULD COMPANY

Winchester, Indiana

For All Types of Glassware Moulds

OVERMYER MOULD CO. of PENNA.

Greensburg, Penna.

For Screw Products

OMCO PRODUCTS CORPORATION

Springfield, Ohio

MAIN OFFICE . . . . WINCHESTER, INDIANA

GLASS SPECIALTIES

Transparent Colored Blown Sheet Glass
Solid Pot Opal Blown Sheet Glass
Flashed Opal Blown Sheet Glass
Colonial Antique Colored Glass
Heat-Ray Resisting (Cool Glass)
"TWIN-RAY" — the scientific illuminating glass.

HOUZEX

L. J. HOUZE
CONVEX GLASS CO.
Point Marion, Pennsylvania
New York Office: 110 West 40th St.
Chicago Office: 1597 Merchandise Mart
"IF IT'S MADE OF GLASS, ASK US FIRST"

THE OTTAWA SILICA COMPANY

OTTAWA. ILLINOIS

THREE PLANTS TO SERVE YOU

OPERATING YEAR AROUND

Defense Savings Pay-Roll Allotment Plan

How company heads can help their country, their employees, and themselves

voluntary pay-roll allotment plan | **helps** workers provide for the future | **helps** build future buying power | **helps** defend America today

This is no charity plea. It is a sound business proposition that vitally concerns the present and future welfare of your company, your employees, and yourself.

During the post-war period of readjustment, you may be faced with the unpleasant necessity of turning employees out into a confused and cheerless world. But you, as an employer, can do something *now* to help shape the destinies of your people. Scores of business heads have adopted the Voluntary Pay-roll Allotment Plan as a simple and easy way for every worker in the land to start a *systematic* and *continuous* Defense Bond savings program.

Many benefits . . . present and future. **It is more than a sensible step toward reducing the ranks of the post-war needy. It will help spread financial participation in National Defense among all of America's wage earners.**

The widespread use of this plan will materially retard inflation. It will "store" part of our pyramiding national income that would otherwise be spent as fast as it's earned, increasing the demand for our diminishing supply of consumer goods.

And don't overlook the immediate benefit . . . money for defense materials, quickly, continuously, *willingly*.

Let's do it the American way! **America's talent for working out emergency problems, democratically, is being tested today. As always, we will work it out, without pressure or coercion . . . in that old American way; each businessman strengthening his *own* house; not waiting for his neighbor to do it. That custom has, throughout history, enabled America to get things done *of its own free will*.**

In emergencies, America doesn't do things "hit-or-miss." **We would get there *eventually* if we just left it to everybody's whim to buy Defense Bonds when they thought of it. But we're a nation of businessmen who understand that the way to get a thing done is to *systematize* the operation. That is why so many employers are getting back of this Voluntary Savings Plan.**

Like most efficient systems, it is amazingly simple. All you have to do is offer your employees the convenience of having a fixed sum allotted, from each pay envelope, to the purchase of Defense Bonds. The employer holds these funds in a separate bank account, and delivers a Bond to the employee each time his allotments accumulate to a sufficient amount.

Each employee who chooses to start this savings plan decides for himself the denomination of the Bonds to be purchased and the amount to be allotted from his wages each pay day.

How big does a company have to be? **From three employees on up. Size has nothing to do with it. It works equally well in stores, schools, publishing houses, factories, or banks. This whole idea of pay-roll allotment has been evolved by businessmen in cooperation with the Treasury Department. Each organization adopts its own simple, efficient application of the idea in accordance with the needs of its own set-up**

No chore at all. **The system is so simple that A. T. & T. uses exactly the same easy card system that is being used by hundreds of companies having fewer than 25 employees! It is simple enough to be handled by a check-mark on a card each pay day.**

Plenty of help available. **Although this is *your* plan when you put it into effect, the Treasury Department is ready and willing to give you all kinds of help. Local civilian committees in 48 States are set up to have experienced men work with you just as much as you want them to, and no more.**

Truly, about all *you* have to do is to indicate your willingness to get your organization started. We will supply most of the necessary material, and no end of help.

The first step is to take a closer look. **Sending in the coupon in no way obligates you to install the Plan. It will simply give you a chance to scrutinize the available material and see what other companies are already doing. It will bring you samples of literature explaining the benefits to employees and describing the various denominations of Defense Savings Bonds that can be purchased through the Plan.**

Sending the coupon does nothing more than signify that you are anxious to do *something* to help keep your people off relief when defense production sloughs off; *something* to enable *all* wage earners to participate in financing Defense; *something* to provide tomorrow's buying power for your products; *something* to get money *right now* for guns and tanks and planes and ships.

France left it to "hit-or-miss" . . . and *missed*. *Now* is the time for *you* to act! Mail the coupon or write Treasury Department, Section A, 709 Twelfth St. NW., Washington, D. C.

FREE - NO OBLIGATION

Treasury Department, Section A,
709 Twelfth St. NW., Washington, D. C.

Please send me the free kit of material being used by companies that have installed the Voluntary Defense Savings Pay-Roll Allotment Plan.

Name _____

Position _____

Company _____

Address _____

THE SHARP-SCHURTZ COMPANY

CHEMISTS AND CONSULTING ENGINEERS

FOR THE GLASS INDUSTRY

LANCASTER, OHIO U. S. A.

GLASS SLICING MACHINES

• We manufacture a variety of wet glass slicing machines for solid glass bars, glass tubing, etc. We can also supply a full line of special glass working machinery for the production of television tubes. fluorescent tubes, incandescent lamps, glass ampules and vials. Glass working lathes and laboratory equipment of all kinds. Cross Fires and Torches. Ask for our catalogue.

•

EISLER ENGINEERING CO.
CHAS. EISLER, Pres.
742 SOUTH 13TH STREET
(Near Avon Avenue)
NEWARK, N. J.

MIN-OX

The Binney Castings Company

Originators of Alloys for Glass Moulds

2555 Dorr Street Toledo, Ohio

Ransome MIXERS
for the Glass Industry

• Fully Dustproof • Designed to Produce
• Self Cleaning a More Uniform Mix

Industrial Division
RANSOME CONCRETE MACHINERY CO.
DUNELLEN, NEW JERSEY

Aplite

This new material for incorporating ALUMINA in glass at lower cost is providing excellent results.

DOMINION MINERALS, INC.
SHOREHAM BUILDING
WASHINGTON, D. C.

Pioneer Producer of APLITE
AlNaK

POLAROID
Glass Inspection polariscope
Large Field—Brilliant Strain Patterns
Adjustable—Binocular Viewing—Precise

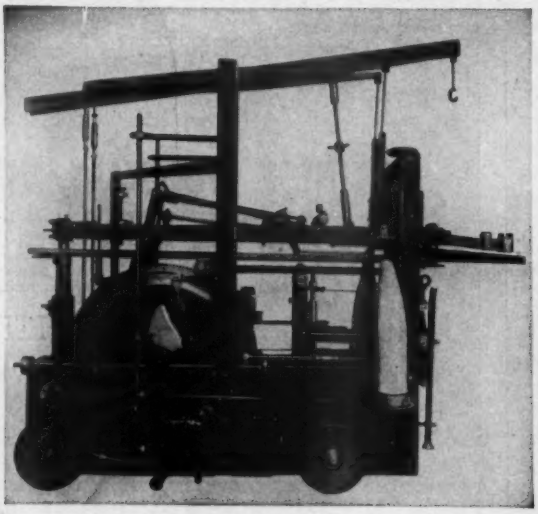
If your problem is strain detection we can help you through Standard Equipment or Special adaptations.
Send for descriptive bulletin

THE POLARIZING INSTRUMENT CO.
630 Fifth Avenue (Rockefeller Center) New York City

ROIRANT

SINGLE AND MULTI-MOULD MACHINES

Universally known for the production of small and large bottles



Type "F" single - mould suction machine for the production of small ware

Type "A6" twin table six-arm suction machine for the production of bottles

Also type "B" single-mould suction machine for bottles and type "BB2" suction machine for carboys up to a capacity of about 14 gallons

Any particulars from:

SOCIÉTÉ CONTINENTALE
D'APPAREILS MÉCANIQUES POUR LA VERRERIE S.A.
7, rue Chaillet, Fribourg, Switzerland